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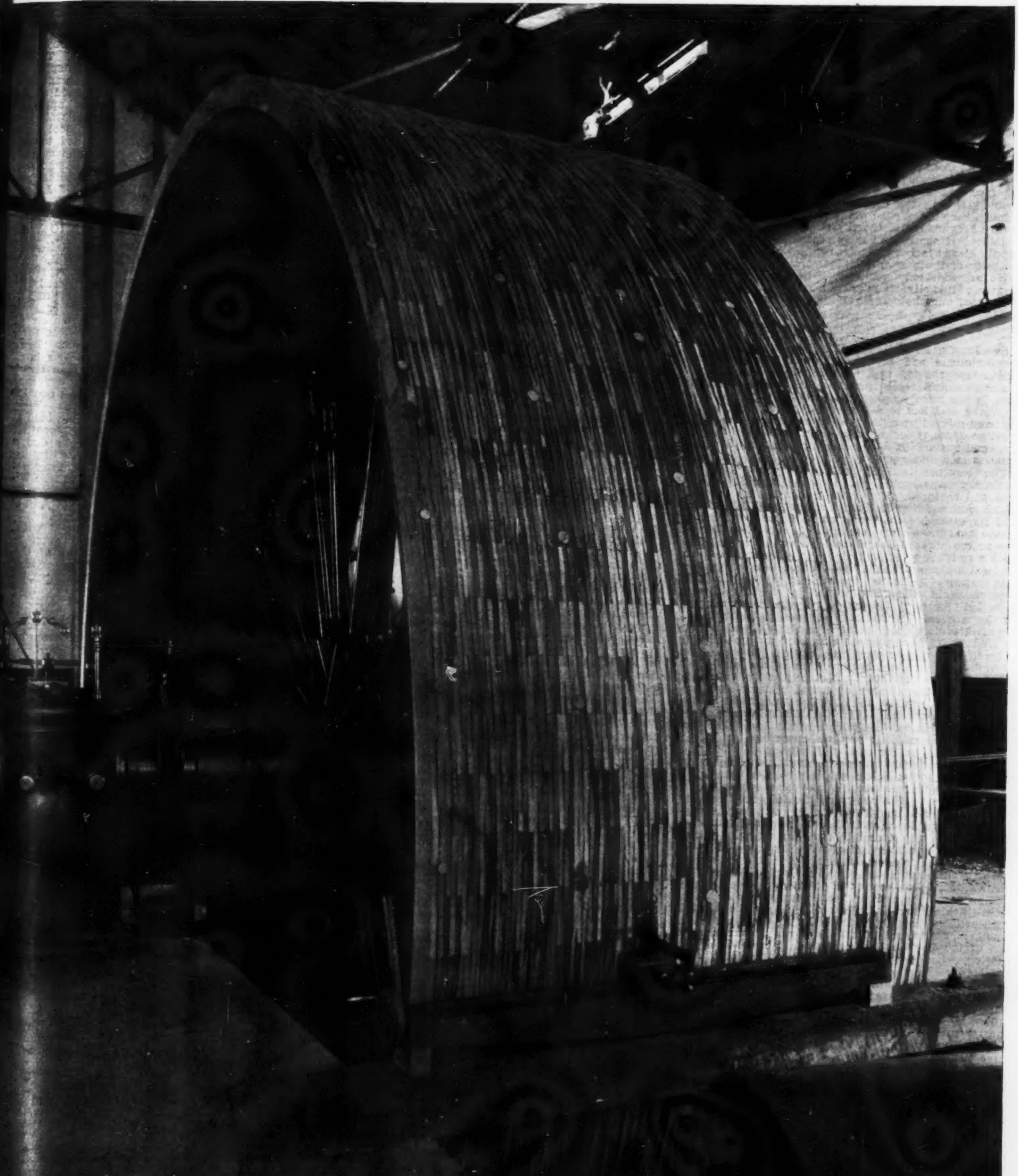


ATTACHING A SINGLE-CROWN WOODEN FACE TO A FOUR-CROWN CAST-IRON 55-TON ENGINE PULLEY.

WIDTH OF FACE, 7 FEET 6 INCHES: DIAMETER, 25 FEET 11 INCHES.

CHANGING A FOUR-CROWN TO A SINGLE-CROWN PULLEY.

We present a remarkable illustration of a very interesting alteration which was recently carried out upon a large engine flywheel at the Dyer Dam Power House, Danielson, Conn. The wheel, which originally weighed 110,000 pounds, has a diameter of 25 feet and a width of face of 7 feet 6 inches. Originally, the face carried four similar crowns and was belted to four separate generators. In rearranging the plant, it was desired to use a single generator belt 84 inches in width for driving the one generator which was to take the place of the four units first installed. It was considered, however, that there was not sufficient thickness of metal in the rim to admit of turning off the four crowns into a single crown, the necessary reduction in the metal being such as would seriously impair the strength of the rim, and a way was found out of the dilemma by building a wood pulley on the face of the wheel, and turning the rim surface to a single crown. The wooden face was built up of kiln-dried sweet gum wood, the segments, which were 16 inches in length by 6 inches in depth and 13-16 of an inch in thickness, being laid on edge. As a preliminary operation, five rows of holes were drilled around the periphery. A backbone of six segments was then secured to the central row of holes by means of carriage bolts. From this foundation the segments were built out on each side, piece by piece, glued, nailed and bolted to the rim, the segments being staggered so as to break joint. The carriage bolts were sunk in the segments and the holes plugged up with dowels, glued in place. A temporary wooden turning lathe and rest were secured on a stout stick of timber, which extended across the wheel-pit, immediately in front of the wheel, and the face was turned to the desired dimensions and form by setting the engine wheel in motion. After turning, the surface was well sandpapered and shellac thoroughly rubbed in, thereby securing a smooth and suitable belt contact. The increase in diameter was exactly eleven inches at the crown, making the largest diameter of the new wheel 25 feet eleven inches.

We are indebted to Messrs. Patterson, Gottfried & Hunter, of this city, who designed and built the wooden facing, for our photograph and particulars.

DEEP SEA HOSPITAL SHIPS.

St. John's, N. F., June 11 (Special).—While the Newfoundland and French fishermen on the Grand Banks are provided with hospital ships and the most modern medical accessories, the United States fishing fleet in the same waters is without any such humane auxiliary, and has to depend for the treatment of its sick and injured upon the ministrations of the medical services of its rivals, or else has to suffer the loss of time and business involved in coming to land to place helpless men under proper care.

The Newfoundland Medical Mission has been at work now some twelve years, and is splendidly organized and equipped. The mission is a branch of that which works among the British seamen and fisher folk, and its extension to Newfoundland has been of immense benefit. To-day it maintains three hospitals—one on the "French Shore" and two on Labrador, each with a resident doctor, a trained English nurse, a staff of local assistants and a stout steam launch for the conveyance of patients. In addition, there is a fine modern yacht, the "Strathcona," a steamer of 600 tons, built by Lord Strathcona, and presented by him to the mission. In this ship the superintendent, Dr. Grenfell, cruises every season from the Grand Banks to Hudson Bay, treating all who come to him for aid, regardless of race or class or condition, the same rule prevailing in all the other branches of the mission.

The total cost of this work each year is now about $20,000, and the number of house patients (serious cases) in 1902 was 110, and of out patients 2,664. Some thirty-five operations under anæsthetics were undertaken, and eight deaths occurred in the hospitals or on the ship. The majority of these cases had no chance whatever of any other skilled assistance. It was not a question of better or worse treatment, but of suffering or dying without medical aid at all other than what the mission afforded. Some of the cases are unique in medical annals. The two-year-old child of a Labrador settler wandered away from the doorstep in the winter, and when found both her feet were frostbitten. Mortification set in, and to save her life the father chopped off both extremities with his wood axe. In due course the mission doctor reached the place with his dog sled, and found the little sufferer almost at death's door. But he treated the stumps scientifically and preserved the child in health, even if she is stricken with this infirmity. The child has now been fitted with artificial legs, and adopted by an English family. Another case is that of a little boy, the four-year-old son of the Hudson Bay Company's factor at Rigolet Station, who was worried by savage Esquimau dogs until there were eighty-seven separate bites on his puny body. He was hurriedly brought to the nearest hospital, where he eventually recovered, though at first little hope was entertained of this.

Equally remarkable are the cures effected among the fishermen on the Banks. Most of these are surgical cases. Men are crushed by falling or breaking spars, have ribs or limbs fractured in storms, or are the victims of gunshot accidents. The "Strathcona" in her cruises meets most of these, and the patients are either transferred to her or, if not bad enough for this, treated on board their own vessels. If the cases are desperate or the yacht's accommodations crowded the ship is ordered to one of the hospitals and the man is housed there. Skippers, too, make for these centers of their own accord when a mishap occurs to their crews and the yacht is not near. French, Portuguese, Canadians, Americans—all avail themselves of the missions, and their generosity gets abundant play here. The story is told of one Yankee skipper who asked the hospital doctor if he would like a fresh fish for the patients, and, being answered in the affirmative, sent ashore a halibut weighing over a hundredweight and taking four men to carry. Staff and patients ate of it while they could, but had ultimately to bury its remainder some distance away, being without sufficient ice to preserve it. But, apart from this, these fishermen all pay in cash for their medicine and food, the seafarer, as a class, being about the most independent man alive, and knowing only too well from sad experience afloat what a boon it is to secure such ministrations in time of sickness or misfortune.

The ship and the hospitals have the latest devices in medical science, including the X-ray apparatus. They are lighted by electricity, and are as well kept as much more pretentious institutions. The Newfoundland fishermen, working from their own coast and Labrador, and only a day's run seaward, do not need a hospital ship so much as they do a kindred institution on shore, and that is why these three buildings have been erected. Fully twenty thousand Newfoundland men are engaged in the fishery on the Banks and Labrador every season, and until the mission was established they had no medical aid whatever. Even as it is now, there is work for a larger staff than that employed, but this is naturally limited by the funds at the mission's disposal. Another work which it does that is of great good is in feeding the hungry and clothing the naked "livyeres" (live-heres, or permanent inhabitants) of Labrador, when the approach of winter threatens these wretched beings with death in its worst form—i. e., from starvation and cold.

Some idea of the misery these Labradorians endure can be realized from the fact that while the population of Newfoundland increased by 10 per cent during the last decade that of Labrador declined from 4,211 to 3,586. The decline would have been much greater but that the mission was there to arrest it by medical services and providing food and raiment when bad fisheries left death inevitable otherwise. No more self-sacrificing life can be imagined than that of these medical missionaries ploughing the ocean in their hospital ship or making long journeys up and down the coast by boat in summer or by dog sled in winter. The dreadful monotony is broken only by the fortnightly visits of the mail steamer from St. John's, which calls at the different harbors to set off and take on mails, and from May until November the mission boats are occupied in their labors of love, affording their medical skill and creature comforts to the thousands of fisher folk who are obliged to depend for these attentions upon the philanthropic efforts alone of this splendid institution, which is doing such admirable work for stricken and suffering humanity in this land of desolation.

The hospital service for the French fishermen was established in 1899 by the Société des Œuvres de Mer. This association fitted out a fine schooner, the "St. Pierre," of St. Malo, and dispatched her to the Grand Banks. She had the misfortune to be driven on the Newfoundland coast and completely wrecked on her first voyage, with the loss of four men, but she was speedily replaced by another of the same name. In 1900 this ship was again in commission, but in 1901 she was replaced with a steamer, the "St. François d'Assise," a fine ship of 720 tons, 300 horse power and ten knots speed, besides a full sail plan, so that coal could be economized whenever possible. In the construction and arrangement of this ship everything that experience and ingenuity could suggest was provided for the sick and injured fishermen who were to be treated on her, she being an ideal naval hospital. She has a spacious ante-chamber, with hot water bath for the ailing and for castaways; a consulting room, a pharmacy, a library, an operating room, a surgery for dressing wounds, a disinfecting chamber, and the hospital proper. This has beds for thirty-six persons, while the ship's company is twenty-seven more, including two physicians, four male nurses and a priest to minister to the spiritual needs of this floating parish.

There are about eight thousand Frenchmen engaged on the Grand Banks every summer, and last season this ship made six cruises, among them five to the outer banks and one to the inner which face the Newfoundland "French shore." During the six months of her work she communicated with 509 French fishing vessels, had seventy-four sick persons as in-patients, and treated 347 lighter cases. Besides this, she rescued twenty-one persons who were adrift in their dories and came within sight of her; twenty-six were transferred to her by other vessels which had picked them up, and she took off the sinking hull of the French schooner "Navarraise" eighteen others in imminent danger of death. All of these she conveyed to St. Pierre-Miquelon, where the marine authorities looked after their needs, the ship carrying stores of clothing to properly clothe such unfortunates as she might find adrift.

On one occasion last year she brought in fifteen men stricken with typhoid fever—the crew of a French vessel in which the disease had raged unrestrainedly. The craft was waterlogged and helpless when the yacht sighted her, the crew having been too ill to attend to her navigation. She was set on fire after the stricken sufferers had been removed from her, and soon vanished below the waves. The crew, several of whom were dangerously ill, recovered in time, except one, who died from weakness. All would have perished but for the hospital ship. Another time she rescued the crew of eight men from a crippled lumber bark, landing them at St. Mary's, on the south coast of Newfoundland. Besides this, she distributed 11,000 letters among the French fishing fleet, and her kindly offices were freely availed of by the fishermen of other nationalties trawling on the banks.

In the course of her peregrinations during weather that was sometimes calm, but more often "dirty," she carried on her work every day, her lifeboat visiting crafts which showed a distress signal, when it was too rough for their dories to reach her. At other times she had to send back in her boats men who had come to her in dories, as these were crushed by the seas against her sides. The extraordinary incidents identified with these dories exhibit in a sombre light the difficulties and dangers of the life led by these codfishers of all nationalties. Every year there are scores of victims swallowed up by the impenetrable fogs and insatiable seas, as the little skiffs are abroad upon the waters and the pall of fog shuts down and blots out their vessels, leaving the dorymen helpless castaways, without food or water. Usually death is their fate, but if they escape that it is oftentimes only at the expense of frostbitten feet and arms, which have to be amputated after entailing agonies beside which death itself is almost preferable. French fishermen are among the worst sufferers from these causes, as they often wear sabots with wisps of straw within, and no stockings, instead of being well shod with stout woolen socks and strong rubber knee boots, as are the American and Newfoundland fishermen who frequent the Grand Banks.

That the United States fishermen have been without a hospital ship or similar institution for so long is all the more remarkable when it is remembered what philanthropy has been accomplishing in other directions. It is thought that Congress might make an appropriation for such a purpose, on the same principle that it maintains the life-saving service. This would certainly be regarded as a most praiseworthy benefaction, offering, as it does, medical aid and the best of comforts and attention during sickness or accident to a most worthy class of workers while they pursue their hazardous occupation. It is believed that it would be a rare chance for some wealthy citizen to display his philanthropy with good effect in providing a ship which a government appropriation might maintain in the most efficient manner.

The Newfoundland mission is kept up by private subscriptions in England and in this colony, aided by an annual vote from the Colonial funds. The French hospital ship is the property of a public spirited association, and is aided by a government grant in recognition of the fact that the fishery is used as a naval nursery. The same argument should apply to the United States fishing interests in these waters. That industry is regarded as a training school for naval seamen, and on this account is entitled to financial assistance toward providing medical and surgical aid for the thousands of Yankee fishermen who are scattered over the expanse of the Grand Banks from the shallows beyond Fundy to the ledges off Labrador.—N. Y. Tribune.

THE SNEEZE AND ITS DIAGNOSTIC VALUE.

A friendly correspondent sends the National Druggist a clipping from a medical journal, in which a very distinguished English surgeon is represented as declaring that "when a man sneezes heartily he may know himself to be in the best of health," and further that "no person in poor health was ever known to sneeze." The sender requests our opinion on the subject. It is easily given—we think that the paragraph is a "fake"—pure rot, got up by some "newspaper scientist," hard up for an item. It seems impossible that so close an observer as Sir Jonathan Hutchinson has shown himself to be in his writings generally, should make so dogmatic an assertion when the contrary is so easily proven.

The fact is, that the majority of people, both ancient and modern, with the exceptions noted hereafter, seem to have regarded the act of sneezing as one usually fraught with evil. The custom still existing in many lands and among many peoples of uttering a salutation or a benediction on hearing one sneeze is a survival of a traditional fear of evil foreshadowed by the act. Some time ago a German contemporary, in answering a question regarding the origin of the almost universal Teutonic habit of saluting a sneeze with "*Zum wohl*," or "*Gott segne dich*," or "*Gesundheit*," stated that it originated during the prevalence of the great plague, in the 14th century. One of the earliest symptoms of infection was a sneeze, single at first, but soon followed by a number of sternutations in quick succession. When a person sneezed, therefore, it was assumed that he was infected with the plague, and all who were near him commended him to the care of heaven, and lit out hot-foot to get away from him.

This is the view generally held of the origin of the custom as it prevails throughout Europe to-day, but it will not bear investigation, since similar customs prevail among the wildest tribes of Asia, Africa, Australasia, etc. Besides this, the literature of Greece, Rome, Egypt, the Jews, and other ancient peoples is full of allusions to similar superstitions in regard to sneezing. Aristotle—to show that the custom of saluting a "sneezer" was an ordinary (and therefore ancient) one in his day, undertakes to explain it by declaring that "when one sneezes and those near salute him, the salutation is in honor of the brain, which is the seat of the understanding and wit."

The Jewish Rabbis maintain that Adam sneezed for the first time at the exact moment when our first mother held out the apple-core for him to take a bite. In memory of this, Adam regarded the act as an evil omen, and a presage of approaching death. In this light it was held down to the time of Jacob. The latter sneezed one day, and not caring to die for such a trifle, besought the Deity to change the order of things, and out of regard for the patriarch the prayer was granted. From that time, according to learned doctors of the law, it has been the custom for the bystanders, when one sneezes, to wish him health and happiness.

Bible readers will remember how, after the prophet Elisha had stretched himself upon the body of the dead son of the Shunamite woman, and "the flesh of the body waxed warm, . . . the child *sneezed* seven times, and the child opened its eyes." (II. Kings, iv. 35.)

The Greeks, who refined upon all ancient and inherited customs, and after them, the Romans, had an elaborate code by which they distinguished whether a sneeze was to be regarded as a benignant or a malign portent, the distinction being made according to the time, place and circumstances of the sternutation. Thus, if one sneezed between mid-day and midnight, the augury was happy, unless the moon chanced, at the time, to be in the sign of the Virgin, the Balance, the Crab, or the Scorpion, when it became an evil omen. Sneezing as one rose from the table or the bed was an augury of most malign portent, foretelling approaching death to the sneezer. Both Greeks and Romans regarding "sneezing to the right" (i. e., bending or turning to the right, as the sneeze occurred), as a most happy omen. The Greek, in speaking of a person who had a beautiful face or figure, would say, "Surely Eros" (Cupid, or the Graces, as the case might be) "sneezed when he or she was born."

Father Famien Strada, who has made the most erudite researches into the history and literature of

the sneeze, declares that Prometheus introduced it to mortals. He had made a statue which he wished to endow with life, and for this purpose he stole a beam of sunlight. Wishing to conceal the theft from Apollo, he hid the beam in his snuff-box. Shortly afterward, being desirous of taking a pinch of Maccaboy, he absent-mindedly put the beam up his nose—causing him to sneeze violently.

Many savage and semi-civilized races of the Orient have some curious customs regarding the sneeze. When the Sultan of Monomotopa sneezes, for instance, the fact is made known from the palace by a certain signal. Instantly, every subject within hearing of the signal sets up a shout, the cry is taken up by others, and so extends until it rolls throughout the confines of his empire. When the Sultan of Senaar sneezes, on the contrary, every woman in his harem or within hearing, turns her back on him, and makes a sign of contempt, by smiting her lips with her hands—disgusted that so mighty a personage should have to sneeze like an ordinary mortal.

The Inca, Garcillasso de la Vega, in his narrative of DeSoto's expedition through the Gulf States, Georgia, etc., states that while DeSoto was camped on the banks of the Savannah River, and interviewing the king or head man of the country, his Indian majesty sneezed loudly. Instantly all his subjects bowed low their heads, opened and closed their arms, and saluted the chief in chorus with the following

May the sun guard thee!
May the sun be with thee!
May the sun shine upon thee!
May the sun prosper and defend thee!

THE APOTHECARY.

By J. W. WAINWRIGHT, M.D.

IT is well known that everything pertaining to medieval education, science, and art originated in Italy. The monks who were dispatched from the Papal Court were instructed in these several branches of education, and as they spread over the continent of Europe, became active in a propaganda for the dissemination of these higher educational and intellectual pursuits, thus laying the foundation for the advancement and power of the Church. Medical establishments of various kinds were instituted, which became places for the vending of medicines as well as the treatment of diseases and injuries, and thus the first systematic effort to apply medicines for the cure of disease was begun in Europe. It must not be forgotten, however, that the knowledge of materia medica did not originate with these monks, for Theophrastus, Hippocrates, and Galen inform us that the Greek and Roman physicians prescribed for their patients medicines which they themselves prepared, but that for economical reasons they caused the herbs, of which the whole of their materia medica consisted, to be collected by others. Many of their medicinal plants were exotics, and it was necessary, therefore, to spend much time and travel in procuring them. These plants were employed in the preparation of foods for seasoning, others in dyeing and painting, some again as cosmetics, others for perfumes, ointments and in the bath. Not a few were used in other arts. It became thus convenient for the physician to purchase such articles as he had occasion to use in medicine from the dealers who might be the gatherers or simply merchants.

As a knowledge of the plants was necessary to those who gathered them, their habitat, appearance, the part used, season for gathering, manner of curing, etc., it can be seen that only those of experience and superior knowledge were engaged in the pursuit. By degrees these people became acquainted with the uses to which certain plants were put in the treatment of disease, and began to encroach upon the calling of the professional physician by selling and compounding medicines, boasting the possession of secrets more beneficial to mankind than known to the physician, especially as the virtues of the plants depended upon the conditions prevailing at the time they were gathered, and the gatherer, not the physician, having a knowledge of whether these conditions were conformed to. The sun and planets must be in certain constellations; besides, the hour of day or night when gathered influenced their potency.

Then dealers were distinguished as *pigmentarii*, or those who dealt principally in those plants used in dyeing and coloring, *seplasiarii*, or those dealing in remedies used in veterinary practice, the *pharmacopolæ* or those used as medicines and made according to standard formula of the physician, and finally the *medicamentarii* or dealers in medicinal plants and herbs. Notwithstanding these distinctions, they all more or less dealt in the various kinds of plants, in proof of which a law was established for the punishment of a *pigmentarœ* who sold by mistake poisonous substances as remedies.

Again Pliny reproaches physicians of his time for purchasing medicines from the *seplasiarii* instead of preparing them himself, and thus being assured of their contents. The *pharmacopolæ* carried on the trade of prescribing and boasted of extravagant virtues for their products. The *medicamentarii* were not popular. The Theodosian code denounces them as worthless, while male and female poisoners were known as *medicamentarii* and *medicamentariæ*, thus casting opprobium upon the calling. These dealers in herbs resembled more our grocers, druggists, and mountebanks than apothecaries, the word *apotheca* signifying a store, magazine, or warehouse, while *apothecarius* was the proprietor or keeper of such a place. As used in the writings of the thirteenth and fourteenth centuries, therefore, the term apothecary did not have the same meaning as later.

In these periods apothecaries were attached to courts and in houses of wealthy persons, and were engaged in preparing preserves and confections, and therefore, would be considered rather as confectioners.

It is not certain when apothecaries became semi-professional men with a knowledge of materia medica and chemistry necessary to enable them to properly prepare the physicians' medicines. It is probable, however, that they gradually acquired this knowledge, and that when the physician found a skilled druggist, he for convenience's sake confided to him the compounding of his prescriptions.

Corning* asserts that as early as the eleventh century African physicians began to employ skilled herbalists in the preparation of their medicines. The practice was then introduced into Spain and lower Italy through the Saracens by the Arabian physicians, who accompanied the Caliphs or Arabian princes into these countries.

In this manner we can account for the origin of the many Arabic terms in pharmacy and chemistry, which were adopted and retained, and the supposition that the first apothecaries were found in lower Italy. At all events the first known legal establishment of the business of apothecary is the medical edict of Frederic II. for the Kingdom of Naples.† By this edict *confectionarii* were required to subscribe to an oath to keep fresh drugs and to prepare medicines strictly according to the prescriptions of the physicians. The price was fixed at which the *stationarii* might vend medicines so prepared. Physicians were charged with the inspection of the *stationes* which were restricted to certain towns. The *confectionarii* were those who prepared the medicines or confections, and the *statio* or what was later termed the apothecary's shop, the place where they were sold; the *stationarii* were the proprietors of the shops, and had the care of selling the medicines. In this edict the word *apotheca* is used only to signify the warehouse where drugs were preserved. It appears that the *confectionarii* prepared medicines from a general set of prescriptions legally authorized, and that the physician selected from those kept ready for use, such as were thought best adapted for the particular case under treatment. The physician, who was required to pass an examination and then obtained a license to practise, was obliged to swear to observe *forman curiæ hactenus observatam;* and if he found *quod aliquis confectionarius minus bene conficiat* to give the information to the curia. The *confectionarii* swore that they would make the confectiones *secundum prædictam forman.*

It was necessary that the medicine should be accompanied with a certificate from a physician to show that it was properly made. After the invention of distillation, sublimation and other chemical processes, laboratories, furnaces and expensive apparatus were needed, and it followed that only such men as had studied chemistry as a collateral branch of medicine should become apothecaries, and that they should be indemnified for their time in study and expense in apparatus by an exclusive trade. A monopoly thus sprung into existence which was carefully guarded.

This centering of the business in the hands of the few rendered the inspection more easily accomplished and the selling of improper drugs or poisons was more easily controlled. Apothecaries were allowed to sell sweetmeats and confectionery, and this helped to render them in a comparatively short time financially independent. They were obliged on certain festivals to contribute presents of delicacies to the magistrates, as an acknowledgment for these concessions and thus, probably, arose the custom of sending New Year's gifts, so largely practiced by druggists of our own times.

In many places, and particularly in opulent cities, the first apothecaries' shops were established at the public expense, and hence belonged to the magistrates. A spot was also often appropriated for the purposes of a garden where necessary plants were grown. Even to this day the name apothecary's garden is retained in places, notably the economical garden at Gettingen, which is known to the people as the "Apothecary's Garden." Apothecaries' shops for the courts were frequently established and directed by consorts of princes and from this grew the custom of the preparation and dispensing of medicines by Sisters of Charity in public hospitals.

Anderson in the History of Commerce, 1319, states that King Edward III. in the year 1345 gave a pension of sixpence a day to Coursus de Gangeland, an apothecary of London, for taking care of and attending his Majesty during his illness in Scotland, this being the first mention of an apothecary in the Fœdera.

In France no mention is made of an apothecary previous to the year 1484, when they received their statutes from Charles VIII. (Histoire de Paris par Felibien II., p. 927). These were followed by others in 1514 under Louis XII., and in 1516 and 1520 under Francis I., in 1571 under Charles IX., in 1583 under Henry III., and in 1594 under Henry IV. These regulations were renewed and confirmed by Louis XIII. in the years 1611, 1624, and 1638.

In the beginning of the fifteenth century, an apothecary's shop was established at Stuttgard by one named Glatz, which, as the only one in the country, was sanctioned by the Count of Wirtemberg in 1458. About this time Count Ulric gave to John Kettner, whom he had previously appointed his domestic physician, leave to establish an apothecary's shop in Stuttgard and promised to allow no other in his dominion. The apothecary received yearly from the count a certain quantity of wine, barley, and rye, and engaged to supply the court with confectionery at the rate of twelve shillings per pound.‡

These two shops were soon abandoned, probably because they did not prove profitable.

In the year 1468 Albrecht Mulsteiner or Althumsteiner, from Nuremberg, was appointed apothecary with the promise that no other private or public shop of its kind should be allowed. The patent contained a clause compelling the apothecary to keep a catalogue of the articles offered for sale with prices. Another is mentioned as having been at Tubingen under the protection of Everhard, the possessor of which bound himself to serve as physician and apothecary to the army in time of war.

In the year 1500 Duke Ulric authorized Syriax Horn to establish an apothecary shop at Stuttgard for six years. He was compelled to make oath that he would supply the government and other public officers as well as the duke's subjects, with medicines, and the body physician was enjoined to visit the shop once a year in order to testify whether Horn conducted his place according to regulations and sold his wares at the fixed price.‖

A female apothecary is said to have kept a public shop at Augsburg in 1445, who was paid a salary by the city. In 1507 an order was made enforcing inspection of all apothecaries' shops, and in 1512 a schedule price was arranged for all medicines and other than recognized apothecaries forbidden to deal in them.

About the year 1618 there existed in Hamburg a private apothecary's shop, while in Frankfort, a city physician was appointed in 1489, and instructed to inspect apothecaries' shops carefully, and to see that the proper prices were charged for all articles. In 1500 all the apothecaries were obliged to make oath that they would observe the regulations established for them.

In the police regulations made at Basle in 1440, it was ordered that a public physician should be appointed with the allowance of an ecclesiastical benefice or canonry so that they might furnish their services gratis, but it was stipulated that "What *costly* things people may wish to have from the apothecary's shop, must be paid for by them."

The first apothecary's shop in Berlin was established in 1488. One Hans Zehender was the owner, receiving a hereditary possession with the promise of a certain amount of rye per year, with a free house and exemption from all contributions, watching, or other burthen and without opposition. This agreement was confirmed by the elector John, in 1491, and again confirmed by Joachim I. in 1499, who gave the apothecary a new patent.

Catherine, widow of the margrave John of Custrin, established an apothecary's shop at Krossen for the use of the court which was under the inspection of Wigands, her physician. At her death in 1574 she bequeathed it to the magistrates.

A similar place was established at Halle in 1493 by Simon Puster in order, as stated, that the citizens might like common things at a cheap rate, and that in case of sickness they might be able to procure, readily, fresh and well-prepared medicines. He was exempted from taxation for ten years, with the proviso, "that during that period he should furnish yearly at the council house for two collations during the festivals, eight pounds of good sugar confections, fit and proper to be used at such entertainments." This was the only apothecary's shop in Halle until the year 1535, when the archbishop gave his physician, Von Wyhe, liberty to establish a new one with the assurance that to eternity no more apothecaries' shops should exist in Halle. Notwithstanding this promise, one Wolf Holzwirth returned from Italy and secured permission to establish himself as an apothecary in 1555.

Similar shops were established in Leipsic in 1409. In Eisenach in 1638, in Oldenburg in 1598, in Hanover in 1565, in Brunswick in 1568, and in Dresden in 1581.

In Sweden, the first apothecary's shop was established under King Gustavus Erickson in 1547. When this king died, Master Jacob, the apothecary, Master Yucas and his confessor, Johannes, who according to the custom, practised physic and prescribed for His Majesty.

Toward the close of the sixteenth century, physicians and apothecaries were invited into Russia by the then Czar Boris Godunow.* In England in 1543 an act was passed for the toleration and protection of numerous irregular practitioners, who were neither surgeons nor physicians, entitled "An act that persons being no common surgeons may minister outward medicines"; the persons thus alluded to were those who kept shops for the sale of drugs, to whom the name of apothecary was then exclusively applied. On April 9, 1606, King James I. had incorporated the apothecaries of London and united them with the grocers; they remained thus until 1617, when they received a new charter, forming them into a separate company or guild, under the designation of "The Master, Wardens and Society of the Art and Mysteries of Apothecaries of the City of London." It appears that these apothecaries of London did not begin generally to prescribe as well as dispense medicines until a few years before the close of the seventeenth century.

Unlike as in the United States, there is a distinction made in Great Britain between apothecaries, druggists, and chemists, for while here the terms are applied indiscriminately, in Great Britain the apothecary is a part of the medical profession, exercising the right to practise medicine or prescribe in certain cases; while chemists and druggists are those who have passed an examination and received a license to compound and sell medicines and poisons.

The pharmaceutical chemist is one who has passed a second or major examination and is classed in a higher branch of the profession than are druggists and chemists. In this country the terms are jumbled together, or used indiscriminately by those engaged in selling products used in medicines. The country storekeeper who keeps a few of the most popular patent medicines advertises himself a druggist, while the man who has a drug store is known as a pharmacist and chemist. Very often these words are wrongfully used, as the druggist may be a pharmacist, but may not be a chemist. An apothecary is therefore an anomaly in the United States as is understood in Great Britain, for the laws of the States draw the line sharply between the medical and pharmaceutical profession. The druggist may not prescribe, and in some States the physician may not dispense. This is as it should be, for the curriculum of the medical school does not prepare the student to compound medicines, nor the colleges of pharmacy their students for the treating of diseases. It is safe to say that we will not, for a long time at least, have apothecaries in the sense as now understood.—National Druggist.

HOW A STORAGE BATTERY WORKS.

THE popular impression is to the effect that a storage battery stores up electricity, and that the bottled-up fluid is held somehow under pressure, to be released on demand like highly-charged mineral water. The principle of the storage battery is quite different from this, as the entire action is chemical, fundamentally.

The storage battery is a simple piece of apparatus, mechanically. In its most familiar form it consists of two lead plates supporting active materials—a high

* De Hermetica Medicina libri duo Helmst, 1669, p. 293.
† Conring De Antiquitatibus Academicis, 1739, p. 60.
‡ Sattler's Geschichte Wurtenberg, p. 159.
‖ Beckmann History of Inventions and Discoveries, 1846, Vol. 1, p. 334.

* Backmeister, 1776, p. 37.

oxide of lead for the positive plate, and metallic lead in a spongy, finely-divided state for the negative. The plates are immersed in dilute sulphuric acid, and contained in a glass jar or wooden tank lined with lead. Two plates, one positive and the other negative, constitute a couple, and a cell may be made up of as many couples connected in parallel as the requirements of discharge necessitate. That is, all the positive plates are connected together separately from the negative plates, which are themselves joined in one aggregation, independent of the positives. A battery consists of a considerable number of cells connected usually in series—that is, the positive group of couples in each cell is joined to the negative group of the preceding cell, so that the electric current passes through all the cells seriatim.

Now, "charging" a storage battery simply means passing a continuous electric current through it from some outside source of supply, as a railway or lighting generator, and thereby causing certain chemical actions to take place. The energy of the current is thus stored up as chemical changes and recombinations, or, in other words, it is transformed into potential chemical energy. "Discharging" a battery is naturally the reverse of the process just indicated. The battery is connected to a railway, lighting, or general power circuit, and it at once begins to deliver current, generated by the reversed chemical actions which begin to take place as soon as opportunity is given for a current to flow. Back goes the battery toward its original uncharged condition, and the cycle may be repeated over and over again, always with the same resulting chemical actions caused by, and then causing, the electric current.—Howard S. Knowlton, in the Engineering Magazine.

AN INGENIOUS PORTABLE ELECTRIC DRILL.*

NOTWITHSTANDING the development of small and conveniently handled electric motors, this system of supplying the requisite power for the manipulation of small tools, such as for instance drills, has not come into general vogue. The pneumatic drill has been brought to such a high standard of perfection, efficiency, and utility that it is employed in all ramifications of engineering, the chief advantages recommending its adoption being that it has a low consumption of power, quick operation, and small cost of upkeep. For example, the latest pattern of a twist and drill will bore a hole 1 inch in diameter and 2¾ inches deep in thirty seconds in medium cast iron, and that its upkeep is no more than 25 per cent of the cost per annum.

Yet, despite these advantages, the electric drill is superior to the pneumatic tool in several respects, is much simpler in construction and therefore less liable to derangement, is more powerful and expeditious and far more durable. Messrs. Isherwood & Campbell, of Bootle, Liverpool, have designed a portable electric drill, suitable for all descriptions of engineering work, and far more simple in design than any pneumatic tool of the same type. The manufacturing rights have been acquired by the United States Metallic Packing Company, of Bradford, England, and it is rapidly superseding the air drill, especially in those cases where the work has to be undertaken in confined or cramped spaces, such as for instance the interior of small boilers. It can be accommodated to any class of work owing to its compactness, and the motor can either be carried on a small truck, or slung from a pulley, according to the conditions of the task in hand.

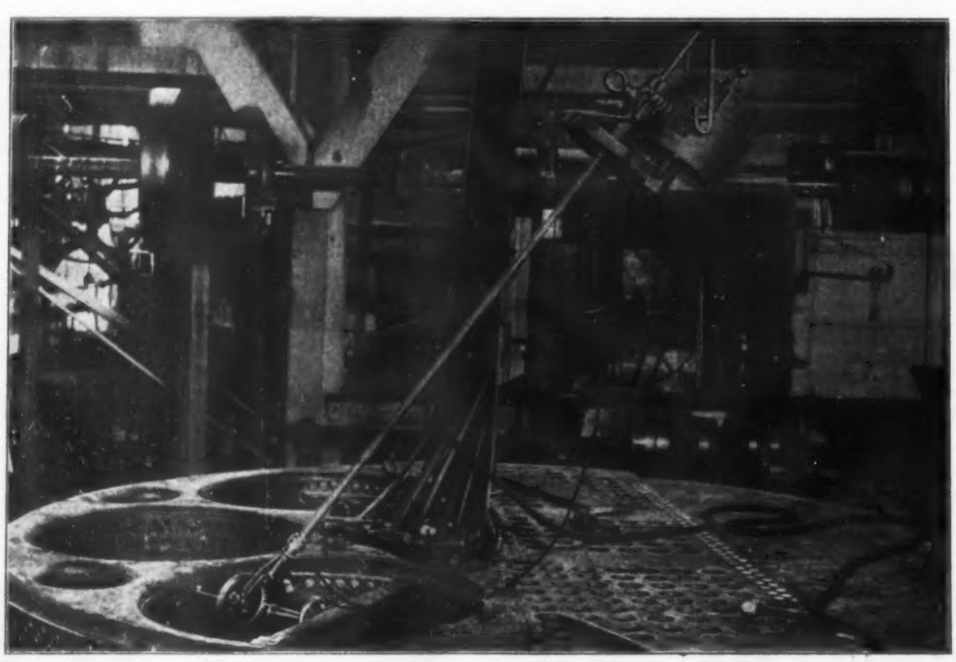
In this electric tool for general working, the motor, which is of the ordinary type, is built upon a small truck fitted with two wheels in front upon which to run and two short iron legs at the rear. It is wheeled from place to place by means of a pair of handles in much the same style as a wheelbarrow, and when released the short legs give the truck a solid and rigid foundation upon the ground, which would not be possible if the carriage were provided with four wheels. The motor is supported upon trunnions in the truck. At the top of the motor is a small bracket which carries a long hollow shaft. At the motor end of this shaft is a spur wheel, engaging on a pinion fixed to the armature shaft of the motor. Inside this hollow shaft is placed another smaller sliding shaft, one end of which is connected to the head of the drill itself. On the inside of the outer hollow shaft is a key engaging in a slot, which extends almost from end to end of the inner sliding shaft. When the outer shaft is set in rotation by the pinion on the armature shaft of the motor acting on the spur wheel, the motion is transmitted to the internal sliding shaft and this of course can be lengthened or shortened, according to the distance it is required to work the drill from the motor.

The drill head is also of simple construction. It comprises two sets of beveled wheels, making four wheels in all, which serve to impart the revolving motion to the drill. At the top of the drill head is a small hand wheel for feeding down the drill spindle when held by the clamp, as shown in the cut. By this arrangement the drill can be manipulated through a complete circle in the plane at right angles to the sliding shaft, and similarly through an almost complete circle in the same plane as the shaft.

THE DRILL AT WORK IN THE DRYDOCK.

A, motor; *B*, portable carriage; *C*, transmitting-shaft; *D*, drill; *E*, clamp.

The drill is at present made to bore holes from 1½ inches up to 3 inches diameter. The former is of 1½ horse power, while the larger size is of 3 horse power. For the working of the 1½-inch drill a current of 110 volts is required, but the machine can be made for the use of any continuous current varying from 50 to 500 volts. Experiments are being made for the utilization of alternate current with the drill. For the 1½-inch diameter drill it is estimated that the 1½ horse power will require about 1,300 watts per hour. At the drill head a switch is provided whereby the operator can stop or set in motion the drill as required, so that he has complete and instantaneous control over the tool.



THE DRILL IN ACTION UPON A BOILER. THE MOTOR SUSPENDED FROM A PULLEY.

For some classes of work it is requisite that the motor should be suspended from a pulley. The manipulation is practically the same in this instance, and, as will be realized from its compactness, portability, and adaptability to small spaces, it is available over a very extensive range of operation. The drill weighs 450 pounds complete: motor 240 pounds, carriage 142 pounds, drill head 44 pounds, and shaft 24 pounds. The electric drill is of especial advantage in all places where electric current is available. The tool can be employed at a comparatively great distance from the source of the electrical energy, as the current power

THE MOTOR SUSPENDED, SHOWING THE PLANE OF ACTION OF THE DRILL.

can be transmitted through ordinary flexible cables, enabling the apparatus to be moved from one place to another with facility. Furthermore, stay ropes or gear are dispensed with, when it is necessary to sling the motor up. From the point of cost of upkeep the electric drill is vastly superior to any other tool, since it will run for five years with but little outlay for repairs.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

UTILIZATION OF ENERGY IN WIRELESS TELEGRAPHY.

THIS was the subject of a paper by G. Ferrié recently read before the Paris Academy of Science. As the energy utilized in wireless telegraphy transmissions with Tesla transformers depends on the capacities inserted in the exciter circuit and on their discharging potential, it is advisable to give the antennæ a large surface, so that tuning is possible with an exciting circuit including high capacities. If, however, induction coils be used, a certain limiting value of the capacities should not be surpassed, as the working of the coil might otherwise be endangered; the antenna will accordingly have to be kept within certain limiting dimensions. As, on the other hand, the discharging potential is nearly inversely proportional to the capacity, the energy utilized will be practically constant. In this case the capacities of the existing circuit should be chosen so as to allow of the antenna being tuned with only three or four turns of the Tesla secondary. It is, however, possible to use several induction coils with the same antenna, connecting them either to one or to different Tesla coils, the secondary circuits of which are connected in parallel or in series to the antenna. Using commercial transformers will afford the advantage of enabling very large capacities (utilizing high amounts of energy) to be employed in the exciting circuit, as the discharging potential within certain limits augments along with the capacity, owing to the resonance phenomena exhibited by the instrument. If, however, given antennæ are to be used, it is not possible to increase very much these capacities, as syntony has to be effected between the antenna and the exciting circuit, the discharging potential being limited. The amount of energy which can be utilized with this arrangement is, therefore, limited as well. Marconi has avoided this drawback by using first the total amount of energy available to produce oscillations of any period in a first circuit including as high capacities as possible, these oscillations being next raised to a rather high tension by means of a Tesla coil, by which another chosen capacity will be charged so that the period of its discharge may be tuned with the antenna by means of another Tesla transformer. The author has found it more suitable to divide all the capacities liable to be charged by a commercial transformer into two or more groups, inserted in different oscillating circuits, but connected to the same oscillator. All these circuits, regulated so as to give rise to oscillations of equal periods, will act on the antenna by means of an equal number of Tesla coils, the secondary circuits of which are connected either in parallel or in series to the antenna. Tuning is effected with the help of the readings of a hot-wire ammeter by acting in the same way on the secondaries if these be connected in parallel, or on one of them if they be in series. As the vibratory motion imparted to the antenna has a period equal to that of each of the excit-

ing circuits, the energy available may be better utilized, while using only the desired wave length. As regards the most suitable form of antennæ, numerous experiments have shown that transmissions would be the more efficient as the ammeters gave higher readings. As, on the other hand, the intensity of the stationary wave will decrease from the ground to the top, it is advisable to secure to this intensity a high value at the greatest possible height of the antenna. Antennæ of great height are, therefore, from this point of view as well, particularly advantageous, though their upper part is in reality of little value. It is possible also to use disymmetric antennæ arranged so that their upper part represents the greater part of the quarter of a wave given by the whole of the antennæ, a considerable intensity being thus obtained over a great part of the height of the antennæ. As to the intensities indicated by the hot-wire ammeters, the author calculates, for an antenna 35m. in length and a reading of two amperes taken at a distance of 1m. from the ground, the mean efficiency intensity of each of the oscillations is about 100 amperes.

THE LABYRINTH OF CRETE.

SINCE the inauguration of the proto-historic studies of archæology by the researches of Schliemann at Tirynthia and Troy, discoveries have multiplied and

FIG. 1.—TERRA COTTA JAR.

thrown some little light upon the obscure beginning of civilization. The part that France has taken in these discoveries is important. Let us briefly recall the researches of Maspero in Egypt, and of Sarzee in Persia, all of which were crowned with the happiest results. The example of these men has been followed by savants of every nationality, who, thanks to liberal private contributions, have been enabled to make excavations in regions whose name, fifty years ago, was unknown to the archæologist, and scarcely known to the historian. Thus, in Crete, for example, Mr. J. Evans succeeded in exhuming a collection of documents which, for the history of art, were unique. According to all probability, it was really the palace of Minos—the famous labyrinth of Crete—that he had the good fortune to bring to light. Situated upon the top of a barren hill, it was covered by but a slight thickness of earth, and presented the peculiarity of having been destroyed at once, in the full tide of its splendor, without any establishment having ever been founded upon its ruins. It was not till three thousand years after its total destruction by fire that the peace of its ruins was disturbed by uninterrupted scientific investigations. The walls of the palace, formed of huge blocks of gypsum, were not buried beneath the successive strata of cities that have disappeared, as at Troy, and the humus that slowly covered them with a veil of oblivion preserved what had escaped the torch of the invaders as well as the lava of Pompeii and ashes of Herculaneum could have done.

The frescoes, with which the walls are covered, are therefore found to be in an extraordinary state of preservation—a fact that may be judged of by reference to Fig. 2, which represents an ephebus carrying a pitcher. The torso, which is of a reddish brown color, is naked, and a drapery embroidered with small trifoils brings into relief the delicacy of its lines. Its attitude is graceful as well as natural, and the profile of its head may be reckoned among the finest productions of ancient painting that we are beginning to know. Other frescoes represent fair-skinned, barenecked women clad in light robes with puffed and flowing sleeves, and talking to each other with animation. We observe likewise scenes of combat in which bold-hearted warriors are thrusting the lance or throwing the javelin in bloody contests. A certain portion of these frescoes belongs to the Ægean epoch which preceded Mycenian times, and as to which archæologists as yet possess but meager information.

FIG. 2.—AN EPHEBUS CARRYING A FLAGON.

Like every palace, that of Minos had complicated subterranean passages in which were concealed treasures inclosed in large terra-cotta jars, the ornamentation of which was of the most original character. Certain of these were over five feet in height (Fig. 1).

The most important part of the edifice, however, was the audience chamber in which the throne was situated (Fig. 3). The walls of this were ornamented with frescoes representing plants irrigated by flowing water. The door was guarded by two dragons covered with peacock feathers. As for the throne, that was formed of a block of hard gypsum ornamented with curious designs, and especially with a sculptured arch of which the motives recall the Gothic style. The statues, which were quite rare, were painted in the natural color of the beasts that they represented, and certain parts, executed in enamel, gave them a striking intensity of life. (Fig. 4.) Let us mention an Egyptian statue representing a seated god, which a hieroglyphic inscription carries back to at least two thousand years before Christ.

The epigraphic discoveries are not limited to this find, however important it be. Mr. Evans has succeeded in exhuming a full series of terra-cotta tablets covered with letters and figures and which, in a manner, constitute the archives of Knossos. The deciphering of these, which is far from being finished, will certainly enrich the proto-history of a host of unpublished documents of the highest interest. Let us add that these tablets are often ornamented with paintings that have reference to the objects contained in the text, to which they serve as illustrations and complement. Thus, for example, we see represented therein slaves, arms, chariots, armor, horses, trees, and flowers. They were probably used as books of commerce. —Translated from La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

FIG. 3.—AUDIENCE CHAMBER WITH THRONE.

FIG. 4.—SCULPTURED AND COLORED OX-HEAD.

AMERICAN ETHNOLOGY.

THERE is no question but when, in the late 70's, Major Powell organized, with the consent of Congress and under the supervision of the Smithsonian Institution, the Bureau of American Ethnology, he had in view the sole purpose of collecting evidence and information and reducing them to a systematic anthropological history of the North American Indians. And in connection with this aim it is gratifying to learn that, notwithstanding the wealth of intellect and unlimited funds devoted to the allied sciences of anthropology and ethnology in the Old World, it has remained for the New, for the United States, to produce the most perfect ethnological history thus far given to the scientific world, a fact gratefully acknowledged by numerous scientific bodies, and further shown by the generous praise bestowed upon it by foreigners whose own lives have been devoted to similar work.

That the most interesting study of man is man is clearly demonstrated by even a cursory examination of the work thus far accomplished by this bureau, and even from a purely commercial point of view the fact that complete sets of the bureau's publications sell over the counters of second-hand book stores in this country and abroad for from $100 to $225 each, and single volumes for never less than $2 each, furnishes tangible evidence of the value of its work.

In these works the Bureau of Ethnology has accurately described the manners, customs, traditions, and languages of the Indians. It has demonstrated the existence of 10,000 languages, and has reduced them to seventy linguistic classes. It has clearly traced throughout the Indian customs the patriarchal system so accurately portrayed in the Old Testament. It has created a system of comparison in "terms of language," a universally acknowledged standard throughout the scientific world. It has produced new and valuable evidence in support of the thesis that mankind advances toward what is termed civilization through four successive stages—the savage, in which the entire conception of law is based on maternal kinship, paternity being usually unknown; the barbarian, in which the kinship of both parents forms the basis of all law; the patriarchal, or semi-civilized, in which tribal rights take precedence over those of the individual, this being the most familiar stage of our own Indians, and the so-called civilized stage, the community which recognizes and, at least to some extent, respects the rights of both nations and individuals, with individual territorial rights and privileges.

Having thus availed itself of the material easily accessible, the evidences of the development of a primitive race existing at the very door of a modern and energetic civilization, the Bureau of Ethnology has familiarized itself with the mental process of this race, and is now prepared to point the way in which to lead the primitive mind up to that mental attitude described as modern civilization.

But, as has been said, the work outlined is almost completed, except that no history is ever complete, and the question of the hour is, to what next will it turn its attention? The answer promptly presents itself. The Indian and the Caucasian have not lived so long in juxtaposition without an intermixture of blood, and a type almost worthy to be called a race, the mestizos, has been the result. The extent to which the mestizo exists in American society is probably realized by few who have not studied the subject. And yet it is a fact that hardly an American Congress assembles without several representatives of this admixture of races. Probably the most striking representative of the mestizo in the public eye is President Diaz of Mexico, a born leader, combining in his views the fire and energy of the Indian with the intelligence and refinement of the white man. What, then, are the results of an admixture of Indian and Caucasian blood, what the fecundity, the viability, the mental and physical characteristics? Science can give no answer now. Perhaps when the Bureau of American Ethnology has turned its attention to this subject a satisfactory answer will be forthcoming.

The negro race in this country represents another interesting problem to which the bureau hopes in time to devote its energies. Each year the census represents less and less accurately the negro population of the United States. According to its figures, all men with African blood in their veins are negroes, and yet it is doubtful if one-half the number enumerated are pure

Africans. Some authorities maintain that the admixture of negro and Caucasian blood results in sterility. Others vigorously contest the proposition, but no scientific study of the subject has as yet been made, nor is it likely to be until the Bureau of American Ethnology extends its scope to take in this problem also.

Still another interesting problem is presented by the progress of the Japanese and the development of the Chinese. Legislating from largely sentimental reasons, Congress has excluded the Chinese. The Japanese are still free to enter the United States. What will be the eventual result of the admixture of Mongolian and Caucasian blood? Which will survive? What mental and physical characteristics will result? What will be the effect on that development called civilization? Even this brief outline of a few of the problems which remain to be solved clearly indicates how far from completed is the work of the Bureau of American Ethnology, and partially answers the question as to the further excuse for its existence.—New York Tribune.

THE MAKING OF THE CLAY PIPE.

AMONG the little things seen in daily life about which most people know very little is the common, ordinary clay pipe. In almost every cigar shop window, in the mouth of every third laborer met, and even in the nursery, this snow-white little instrument of comfort and amusement may be seen; yet few know, for instance, that most of the clay pipes sold in this city of domestic make are manufactured in New Jersey. Woodbridge is the name of the queer little town given over to this odd manufacture, and a trip through one of the factories of that settlement, to follow the pipe from the time it is dug as clay to the time it appears ready for the market, is interesting.

Looking at the chunks and lumps of clay as they are transported from the banks to the factories, one would hardly believe that the snowy, cheap little article could have been manufactured from material so different in color. The color of this clay, before it is burned, is dark gray, like cement. Nor is the process of manufacturing one of these pipes as simple as might be imagined from the absurdly low price. As the clay comes into the factory it is divided finely and put to soak in water for ten to twelve hours. This soaking is to divide the clay to its smallest possible particles so that in the ensuing process it will not cake or lump, and will work smoothly and evenly. This attained, the clay is put into a "pug" mill, where it is stirred by machinery until it gets stiffer and stiffer, until finally it becomes stiff as dough. In this state the clay is roughly molded into lumps and distributed among the pipemakers, who begin the first step in the life of the humble creation.

Grasping a small chunk of clay in each hand, the artist begins work to fashion roughly two pipes at the same time. Rolling the clay between a table and his palms, he quickly produces two carrot-shaped and pointed rolls that bear little or no resemblance to the article when it will be finished. With incredible speed the fashioning of these rolls continues, for ahead of the expert is the problem of manufacturing something like seventy-five gross of pipes within the week. Then the rolls are put away to dry somewhat, and for ten or twelve hours they stiffen so that, once shaped, they will not fall readily to pieces. After that the clay is ready for molding.

The ordinary mold consists of two pieces of iron hinged on the side and opening like a sewing box. Most of the little factories have numerous molds, from the common, unadorned sort that comes in two pieces and is intended for the ordinary plain pipe to all sorts of elaborate patterns that come in six or eight pieces, and are made of brass and intended to fashion pipes in imitation of wooden models that happen to be in vogue. The pipemaker grasps one of the shapeless rolls, tilts the fat end upward—which at once gives the suggestion of a pipe—and runs a wire through the pointed end, out of which the stem is to be pressed.

This roughly fashioned clay is then put into the mold, which is jammed shut, while at the same time a plunger is pressed to enter the mold and to press out the clay, so as to form a bowl. With a dull knife the clay pressed out at the side of the mold is shaved off with a single lightning stroke by the expert, and then once more there must be a drying process, this time in a room heated to about 85 deg., where, as before, the pipe is kept for twelve hours. Except that the pipe is of its original gray color and soft and supplied with the "burrs" where the molded ends are joined, it is now practically finished.

Then comes the process of shaving off the burrs. At this stage the pipe still retains considerable dampness, so that the clay may be cut smoothly, while at the same time a wire is again drawn through the stem, so as to insure proper draught. All is now ready for the pipe in its final state, except that it needs to be burned. For this purpose it is put into a cylindrical vessel twelve inches high and as much in diameter. This is known as a "sagger." Set one against the other, the pipes are adjusted solidly in the sagger, which will hold something like a gross of pipes properly packed. If the pipes consist of the more fancy designs—that is, merely pipe bowls that are to be provided with mouthpieces of wood or rubber—the saggers will hold as many as two gross of pipes. Nine of these saggers filled with pipes are known as a stand, and a medium-sized kiln will hold twenty-one stands and will burn them all at the same time. For five hours the heat in the kiln is kept at a moderate temperature. After that it is allowed to run up, until at the end of twelve or fourteen hours it is driven to a white heat, which gives the pipes their spotless white finish.—New York Times.

The farmers and fruit growers of Oxford, N. J., and adjoining townships, have a new enemy to combat in the shape of a brownish black beetle, elongated in form, and larger than the potato bug. It has four wings, and is so formed that the forward pair form a shell-like covering for the rear pair, with which it flies. This new pest threatens the apple crop, and is making rapid headway. It attacks the fruit by boring through the apple from side to side. Spraying with a strong solution of potash kills the insect.

A NEW SYSTEM OF SEASONING WOOD WITH SACCHARINE OR SUGAR.*

A NEW system of seasoning or vulcanizing timber, thereby increasing its durability and strength, has been devised in England. The process is the invention of Mr. W. Powell, of Liverpool, and the results of the numerous practical experiments with wood which has been subjected to this treatment have proved so successful that it is now being adopted for a variety of purposes where the timber has to resist considerable wear and tear; or is intended to remain for a long period without necessitating repair or renewal.

The inventor was experimenting with a piece of wood afflicted with dry rot, the objects of his investigations being to devise some means of preventing or at least mitigating such deterioration of timber. He found as the result of his researches that, by expelling the air existent between the fibers of the wood, and filling such interstices with a sugar solution, afterward evaporating the moisture by stoving the heated timber at a fairly high temperature, the character of the wood was quite changed and that fresh life was imparted to it. It was converted from the spongy aggregation of wood fiber, moisture, and air, such as is caused by dry rot, into a solid, compact, ligneous substance, the most salient characteristic of which is that it is not influenced or changed in any way under extreme fluctuations of temperature, neither expanding very quickly or appreciably with moisture, nor contracting with heat.

As is well known, sugar, which is nature's great preserving agent, is simply the dried sap of the cane, so that when the fibers of wood are cemented together with a substance very similar to themselves, it is natural that they should become homogeneous, and their qualities of weight, hardness, elasticity, cohesion, and durability, and power of resisting strains be increased to a considerable extent. The introduction of the sugar solution into the interstices or veins between the fibers prevents the wood shriveling, cracking, or splitting, and it is known that under the process of seasoning generally adopted these defects cannot be prevented from appearing.

The process is exceedingly simple. The wood, without any previous preparatory seasoning by the common methods in vogue, is immersed in a saccharine solution and submitted to a prolonged boiling varying from 90 to 200 deg. F., so that the wood may become thoroughly saturated with the solution. As wood is a ready absorbent, this operation entails only a few hours, though it must be explained that the duration of the boiling process varies with the nature of the wood, some being of a naturally closer and lighter grain than others. The wood is then withdrawn from this bath and subsequently inserted in an oven, to extract the moisture from the sugar, leaving only the pure dry sap impregnated in the wood. Owing to the simplicity of this process, the cost of seasoning is very low, both in the initial cost of the plant, labor, and maintenance. At first sight it may appear that the introduction of sugar into the wood may set up fermentation or encourage the growth of animalculæ; but such is not the case. There is no danger of either contingency arising, more especially the latter, as hydrocarbons will not support animal or vegetable life. There is also another drawback which suggests itself, and that is the possibility of the sugar dissolving out of the wood under the influence of moisture, thereby leaving the timber as porous as before treatment. Such, however, is impossible. The sugar matter is entirely absorbed by the celluloid fibers of the wood, becomes homogeneous with it, and not a trace of free sugar can be found in the timber. Curiously enough, it has been proved by practical experiments that this treatment renders the timber more impervious to moisture. An example of this water-resisting capacity is shown from the fact that a piece of treated beech, after being soaked in a bath of water for fourteen days, had only absorbed one-fifth the quantity of water which had been soaked up by a similar unprocessed piece of the same wood in the same time.

A variety of rigorous tests have been carried out to determine the relative superiority of the processed wood over that which had not been subjected to the saccharine bath. A number of blocks of timber, such as are employed for paving purposes, made from six different kinds of wood—spruce, red pine red gum, karri, beech, and elm—were processed, and then submerged, along with similar unprocessed blocks, in water for fourteen days. Every two days accurate and minute measurements and weights were made of each of the woods. The results of this water test were as follows:

comparison, but simply to show the weight of each set of blocks before immersion in the water. It will be observed, for instance, that the processed spruce was 24 pounds lighter than the untreated spruce, though as a matter of fact this wood does not actually lose much weight either way, a feature which characterizes yellow and red pines. These three kinds of wood give up as much in moisture and sap almost as they subsequently retain of dried matter in their pores and fibers. This is a distinct advantage, since if the lighter woods, such as the white, yellow, and red pines, which are so extensively utilized for many building purposes on account of their lightness, became heavier under the Powellizing treatment, then their utility would be considerably nullified. One notable exception to these light woods is poplar, which, as the result of processing, doubles its weight and becomes a hard, tough, solid wood capable of great resistance to wear and tear, while its water-resisting capacity is rendered approximately equivalent to that of beech.

It will be observed by reference to the absorption test table that the unprocessed white and red pine blocks absorbed nearly twice as much water as that taken up by the processed blocks, which fact serves to show that at least half the cavities and interstices in the natural timber had been filled up with solid matter by immersion in the saccharine solution. Unprocessed karri absorbed rather more than twice the amount of water taken in by the treated wood of the same description, which here again goes to show that a large number of the cells in the wood formerly occupied with air and moisture became filled with the solid matter. With regard to the elm, the natural block soaked up one pint of water in fourteen days, causing it to swell appreciably in all its dimensions, while in its treated condition it absorbed only a little over two-fifths of a pint, and only increased its dimensions slightly in two directions. All these woods, moreover, became much tougher and harder by the process, especially the karri, which, as is known, is very soft in its natural state.

The most remarkable change, by reference to the table, will be seen to have taken place in connection with the beech blocks. The natural wood absorbed nearly one pint of water—.925 pint—but the processed timber soaked up less than one-fifth of this quantity—.18 pint—with proportionate alterations in the respective dimensions. The effect of processing the beech renders it practically impervious to water, which testifies that the treatment packs the fibers very closely together. In fact, in another experiment, where a piece of beech badly split was immersed in the saccharine bath, after withdrawal the crack had disappeared altogether, having been closed completely up, the grain compressed, and the fibers toughened so that the wood became as hard as a piece of steel. The processed beech blocks absorbed less than half the quantity of water which was taken up by the natural karri and red gum. Furthermore, under the treatment the beech was rendered much heavier, its specific gravity having been increased by no less than 50 per cent.

For the purpose of obtaining additional conclusive data regarding the increased efficiency of the processed timber, other paving blocks, made respectively of ash, oak, mahogany, maple, and canary wood, were similarly experimented with. The ash and maple gained about 12½ per cent in weight, and improved considerably in texture. Canary wood behaved in much the same manner as the lighter pines, its increase in weight being only approximately 6 per cent. Oak was not much affected in weight, apparently giving up as much as it retains after stoving.

One peculiarity, however, was noted in the course of processing oak. Upon its withdrawal from the saccharine bath it was almost black in color, but this change was found to be confined to the surface. Furthermore, this oak stained the solution, turning it to a dark brown, and any lighter wood immersed in the same solution was discolored, so that it is advisable to treat light-colored woods in one bath and the dark woods in another.

From the results of the foregoing tests it will be seen that saturating the timber in a saccharine solution effects some remarkable metamorphoses in the nature of the wood, rendering it more solid, tougher, and of closer grain; also the timber possesses in this condition an immunity from cracks and splits. What physical and chemical action takes place in the wood is not yet quite clear, and therefore it is not possible to define exactly what change the timber undergoes as the result of the process. Analysts who have carried out experiments with a view to solving the question have not yet found a satisfactory reply to the problem.

One of the great objections raised to many chemically-treated woods to increase their durability, especially those intended for street paving purposes, is that the chemicals introduced into the timber become deliquescent when the wood is exposed to moisture, and that the effect of the processing in thus nullified. With Powellized wood, however, these objections are overcome, as moisture exercises no ill effect upon it whatever.

ABSORPTION TESTS (PAVING BLOCKS).

	Red Pine		Karri		Spruce		Beech		Elm	
	Natural	Processed	Natural	Processed	Natural	Processed	Natural	Processed	Natural	Processed
Original weight, lbs	2.52	2.53	4.19	4.85	2.41	2.17	3.64	5.47	3.86	3.96
" length, inches	9	8 59/64	9 3/64	8 45/64	8 15/16	8 13/16	8 31/32	9 1/16	8 29/32	9
" width, "	3 1/8	3 1/64	2 63/64	2 63/64	3 3/32	3	2 31/32	3 7/64	3	3 1/64
" depth, "	5 1/16	4 15/16	4 21/32	4 63/64	5 1/64	4 63/64	4 31/32	5	5	5 1/16
Weight after 14 days in water, lbs	3.66	3.23	4.77	5.1	3 32	2.72	4.81	5.70	4.62	4.50
Length " " " inches	9 9/64	9 1/32	9 3/32	8 59/64	9 3/32	8 63/64	9 5/32	9 9/64	9 7/64	9 1/64
Width " " " "	3 3/16	3 1/32	2 63/64	3	3 1/8	3	3 1/64	3 3/32	3 1/16	3 1/64
Depth " " " "	5 1/16	4 61/64	4 21/32	5	5 5/64	5	5 1/64	5	5 3/64	5 1/16
Gain in weight, lbs	1 14	.7	.58	.25	.91	.55	1.17	.23	1.26	.54
Increase in length inches	9/64	7/64	3/64	11/64	5/32	11/64	3/16	3/64	13/64	1/64
" width, "	1/16	1/64	nil	1/64	1/32	nil	3/64	1/64	1/16	1/32
" depth, "	nil	nil	nil	1/64	1/32	1/64	3/64	nil	3/64	nil
Quantity of water absorbed, in pints	.905	.56	.465	.2	.715	.435	.925	.18	1.	.435

These figures show some peculiar effects of the Powellized wood, as it is called after its inventor. It must be explained that although the processed blocks were all of the same size, the respective kinds were not quite all of the same weight, so that the original weights of the processed and unprocessed pieces are not noted for

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

Another objection to many woods employed for street paving purposes is that they are remarkably susceptible to the absorption of ammonia, which emits a nauseous odor in warm weather, and besides being disagreeable is also highly insanitary, and furthermore, causes the wood to rot very rapidly. This drawback constitutes one of the greatest difficulties to the municipal authorities of London, and other cities. The ammonia of horse urine penetrates and saturates the wood blocks of the paving and they deteriorate accordingly with great rapidity. Even if the streets are flushed the cleansing water percolates through both the blocks and the interstices between, thus also setting up rot.

Attempts have been made to overcome this difficulty by paving with hard wood, in preference to soft wood blocks, on the plea of greater durability. Both blocks wear, but it is in a curiously divergent manner. The hard wood blocks wear in very much the same way as granite sets. They gradually conform to a humped or rounded superficial shape so that the roadway, if there is much traffic, soon becomes uneven. Soft wood blocks, on the other hand, although they wear more quickly, wear more evenly, and also assume a comparatively smooth upper surface. Hard wood blocks, again, wear very peculiarly on their lower surface, i. e., that laid on the concrete foundation or bed. The under sides conform to the upper side shapes of the blocks, making thereby for themselves a bed in the concrete. The result is that when the blocks are taken up the concrete bed has to be relaid and reprepared, an operation which not only entails great delay, but expense as well. With soft wood blocks, however, the wear is confined to the upper surface entirely, so that when the blocks have to be renewed it is only necessary to replace them, without any preliminary preparation of the concrete foundation. A practical experiment to overcome this grave deficiency is to be carried out by the London city authorities, who intend to repave the Strand thoroughfare with 15,000 Powellized blocks. Should they prove more advantageous and economical than those hitherto employed for this purpose, their utilization will become general throughout the city.

In order to determine the accentuated strength and toughness of the processed timber, a series of bending and compression tests were carried out and some noteworthy results were achieved, the superiority in some instances, such as the white and pitch pines, coming out at 50 per cent over the untreated timber. For these trials the respective pieces of the processed and unprocessed pieces of wood which were of four kinds—red pine, yellow pine, pitch pine, and white pine respectively—measured 18 inches in length by 2 inches in breadth by 1 inch in thickness. The results of these tests are shown in the accompanying table:

maining visible. It must not be imagined, however, that it is one of the peculiar functions of the process to close up entirely all natural cracks, but it does close them partially, and the curious fact is that the wounds in the wood do not ever reopen.

As some substances when saturated in a sugar solution are rendered more inflammable than when in their natural condition, it may be conceived that by substituting wood to this treatment its combustibility or inflammability is accentuated. Such, however, is not the case, for curiously enough it exercises the diametrically opposite effect; and the wood becomes practically noninflammable and fireproof. This feature is due to the closing up and cementing of the wood fibers with the saccharine, so that there is not that loose composition and presence of air cells, as in the wood in its natural state. Two pieces of white pine, of the same dimensions, one processed and the other unprocessed, were placed side by side in a fire. The natural wood flared up and was entirely consumed in 25 minutes, while it occupied seven minutes longer to burn the processed piece, but whereas the former was reduced to a pile of ashes, the latter preserved its original form, being charred, rather than burned, through.

The main advantages of this seasoning process is that it enables softer, common, and cheaper woods to be utilized for those purposes which formerly demanded the employment of the expensive hard woods. It is particularly applicable for ordinary building construction, and ships—more especially for this work, owing to its immunity from expansion, contraction, or warping through atmospheric fluctuations, and its practical incombustibility. Furthermore, it is an inexpensive process, necessitating but little manual labor, and the seasoning does not exceed in cost the process of creosoting. But what is far more important is that fresh or new wood can be passed through the entire treatment of saturation and drying in a few days at the utmost, and is then quite as well seasoned as lumber that has been maturing for years, thus obviating the necessity of retaining the timber in storage in stacks in the yard until fit for use. It is an easy process to learn, owing to its simplicity, and it can be acquired by a person of average intelligence after a day or two's practice, so that expert knowledge is not required in its application. Defective timber, which would otherwise be rejected, can be rendered as serviceable as the sound timber and in this direction alone a considerable economy can be effected, for there is a heavy wastage in every lumber yard through the wood becoming split, cracked, or affected with other natural flaws.

The British government proposes to adopt it in several of its departments, and already it has been

BENDING TESTS.

KIND OF WOOD.	DESCRIPTION.	DIMENSIONS	HOW TESTED	BREAKING LOAD.	DEFLECTION.
		Inches		Cwts.	Inches.
Red Pine	Not processed	18 x 1 13/16 x 15/16	on flat	7½	5/8
Red Pine	Processed	18 x 1¾ x 7/8	on flat	7¾	9/16
Yellow Pine	Not processed	18 x 1 11/16 x 7/8	on edge	6½	½
Yellow Pine	Processed	18 x 1¾ x 15/16	on edge	7¼	9/16
Pitch Pine	Not processed	18 x 1 7/8 x 13/16	on edge	12⅓	5/8
Pitch Pine	Processed	18 x 2 x 7/8	on edge	17	½
Pitch Pine	Not processed	18 x 2 x ¾	on flat	8	¾
Pitch Pine	Processed	18 x 2 x 13/16	on flat	*8	5/8
White Pine	Not processed	18 x 1 13/16 x ¾	on edge	7¼	9/16
White Pine	Processed	18 x 2 x 13/16	on edge	10	3/8

* Owing to the presence of a large knot in this piece of Pitch Pine it was defective and broke at the knot, and not in the center like the other pieces.

As will be observed, the yellow and red processed pines were the best, showing a vast difference in the cohesive power as compared with the untreated timber.

The compression tests resulted as follows:

tested with conspicuous success by Russian and other timber firms, so that it would seem as if there is a great future in store for this processed wood. The British government is particularly desirous of obtain-

•TIMBER COMPRESSION TESTS.

KIND OF WOOD.	NO. OF SPECIMENS TESTED.	DIMENSIONS.	AREA IN SQUARE INCHES.	CRUSHING LOAD PER SQUARE INCH IN CWTS.
Yellow Pine, natural	2	These were all 2 inches long, but differed slightly in the other two dimensions; they were accurately measured for area.—*See next column.*	.875	45
Yellow Pine, processed	2		.70	45
Red Pine, natural	2		.785	52.5
Red Pine, processed	2		.76	64
Pitch Pine, natural	4		.66	57.25
Pitch Pine, processed	4		.66	61

In these trials again the red and pitch pines when processed exhibited a very marked advantage over the unprocessed wood. In connection with the yellow and red pines and spruce the weight was very slightly increased by the processing, but their strength and power of resisting strains and crushing weights was very appreciably increased. But the chief interest in these tests was the difference between the broken-up fibers of the treated and untreated woods, which effect was distinctly in favor of the former. With the processed timber, under crushing the fibers of the wood hold together much more tenaciously than when in its normal condition, and even when the processed wood is split and cracked it still possesses a greater power of resistance than the natural wood similarly injured.

The experiments have shown that although hard and soft woods may both be treated simultaneously, yet it is advisable to process them separately, since hard woods occupy a longer time in treating than the soft woods. Birch, boxwood, and dagame increase about 10 per cent in weight; while new mahogany, wet lancewood, and persimmon decrease in weight. Some woods, however, such as teak, satinwood, walnut, and lignum-vitæ, do not suffer any alteration in weight. In processing certain badly split sections of oak, red elm, and wych elm, the cracks were in the first case closed a little, in the second almost closed, and in the third quite closed up, not a single crack re-

ing an impervious wood for flooring hospitals, and as this timber appears to be eminently adapted to this purpose, and to coincide more closely with such requirements, elaborate experiments are to be carried out on a practical scale to ascertain its efficiency in this direction.

ARTIFICIAL MARBLE.

THE stone trade in this country is on too firm a basis to fear the competition of artificial stone. It is impossible to deny that there is an increasing use of this material, but it will affect brick and terra cotta rather than stone. The tendency of the time is all toward permanent and solid work, and there has never been a period in our history when a more free use has been made of stone than at present. In every city elaborate and beautiful structures of marble, granite, limestone, and sandstone are being erected, many of them showing a profusion of expensive carving. For interior decoration we take tribute from the quarries in all parts of the world, and no marble is too rare and costly to find employment, even in our office buildings. Stone men recognize this and do not fear competition, except among themselves. For this reason they read about the many new formulas for artificial stone and marble merely with curiosity. We therefore reprint the following article from The Illustrated Carpenter and Builder, of London, with no idea that artificial marble will ever enjoy any measure of popularity, or that our fine native stones will suffer in the slightest from its rivalry.

Artificial marbles are usually composed of cement or plaster mixed with other materials, so that the compound may be cast or molded into any desired form; or an ornamental marbled surface may be produced on any suitable hard surface by a process of enameling. An invention which has been patented in this country differs from these processes, inasmuch as ordinary limestone in a solid state is the foundation of the artificial marble. The present invention may be described as consisting of an improved method or process for preparing limestone or any other stone of like nature, or having lime for its basis, by which process the hardness and beauty of natural marble in its various colors may be obtained. In carrying out the invention the limestone, or other stone having lime for its basis, is taken in its natural state and reduced to whatever form may be desired, whether as statues, monuments, fountains, vases, pedestals, architectural decorations of all kinds, columns for gateways, jambs for doors, slabs for steps, or other purposes, squares, octagons, or other forms of tesseræ for pavements, etc.

The limestone or other substance having been brought to the desired form, the work should be carefully finished before it is submitted to the process of petrification hereafter described. The objects thus prepared are placed in a boiler of suitable dimensions to receive them. The boiler should be furnished with a safety valve and manometer, so that the pressure therein may be noted and controlled, as may be required. The objects may be placed in the boiler, either inclosed in a cage in which they are packed, or they may be placed in the boiler without the cage. In either case it is more convenient to fill the boiler with water after the articles have been packed in. The boiler is then filled with pure water at the ordinary temperature, care being taken that there is no mineral deposit introduced with the water. Care must also be taken that the water completely covers the objects placed within the boiler. The boiler is hermetically sealed, and it is well that there should be a strip of lead between the lid and the body of the boiler. The fire is then applied and the water allowed to boil until the manometer indicates five degrees of atmospheric pressure if the objects are small, and six or seven degrees of pressure if the objects are large. When the heat reaches the above mentioned point the water is allowed to cool until the pressure indicated by the manometer returns to zero. The water is then taken out of the boiler, either by means of a pump or a syphon. The objects are next removed from the boiler, preparatory to being placed in the alum or colored bath. If, however, steam alone can be introduced into the boiler (always maintaining the above mentioned degree of heat and pressure), the result attained will be the same, the action of steam, not the presence of water, being necessary for acting on the stone. If steam can be supplied from a neighboring engine, for instance, the process will be more economical.

It is necessary here to remark that care must be taken that the boiler be lined in such a manner that no rust can discolor the water, and there should be a grating placed at the bottom of the boiler, and raised a few inches above the actual bottom, so that the earthy particles which become detached from the stone articles in the process of boiling or steaming should not adhere to the lower pieces or articles.

When it is desired that the object should retain the natural color of the stone, the alum bath, in which they are then placed, should consist of pure water containing five degrees of alum, as indicated by the areometer. The articles must remain in this bath at least twenty-four hours, but they may be left in the same bath for a week, or for a month even, by which time they will acquire still greater hardness; the stone will, however, have become sufficiently petrified for all ordinary purposes in the space of the above mentioned twenty-four hours.

If pure water be used in the boiler, according to the process first described, instead of steam, the alum bath may be effected in the boiler itself, thus avoiding the necessity of removing the objects; but it must be remembered that the application of alum is only admissible when it is intended to preserve the natural color of the stone. In such case the alum is put in the water before the boiling commences, and the objects must remain in the boiler for twenty-four hours after the pressure, as indicated by the manometer, returns to zero.

The articles, when taken from the alum bath, may pass into the hands of the polisher if in the form of plain blocks, slabs, or flat pieces; but if they be statues, busts, vases, columns, or other ornamental works of art, they may be placed in the hands of an artist to finish, if required, as the stone does not attain its greatest hardness until it has become perfectly dry, which will require a fortnight, more or less, according to the size of the object.

When it is desired to impart color to the stone the colored baths are prepared in the manner indicated below, in which the objects must be immersed, and must remain therein at least twenty-four hours. The colored baths must be boiling, or very nearly so, and it is better to remove the objects to be colored from the first boiler and place them in the colored liquid while they are still warm from the steam or water. There is no danger, however, of injuring the stone, even if it should be put into boiling liquid while cold or into cold water while the articles are still heated, but the color penetrates deeper when both stone and bath are in a heated state.

If it be desired to place an object a second time in the colored bath, in order that it may acquire a deep color, it should first be placed in an oven at a temperature of from eighty degrees to ninety degrees, in which it may remain ten minutes, after which it may be immersed in the colored bath. To produce black or dark gray color, take of pure water, two liters; redwood, 300 grammes; fustic wood, 120 grammes; sulphate of iron, ten grammes; sulphate of copper, two and a half grammes.

Boil the redwood and the fustic wood for an hour

and a half, then add the sulphites, and continue the boiling until all the salts are dissolved. Three or four minutes will probably be sufficient for this purpose; the solution may then be passed through a sieve, and half a tumbler of acetic tincture of iron added. This acetic tincture of iron may be made by putting small pieces of rusty iron in strong vinegar, leaving them in for a length of time. The longer the iron remains in the vinegar the stronger, of course, will be the solution.

Stone color or lighter gray is made in the same manner and with the same quantity of water, but with half the quantity of all the other substances; but care must be taken to refill the vase in which the liquid is prepared, as the water evaporates by boiling. In order to prepare a red coloring solution, take of pure water, three liters; Brazilian wood, 330 grammes; scotaus, five grammes; cream of tartar, one gramme; alum, one gramme.

Boil the mixture until all the color of the wood is extracted, and then pass the solution through the sieve in order to remove therefrom any solid matters that may be held in suspension therein. A yellow color is obtained by adding to three liters of pure water, extract of yellow wood of Cuba, twenty grammes; sulphite of magnesia or alum, ten grammes. The mixture must be boiled until complete solution of extract is effected. In order to obtain a green color dissolve in three liters of pure water, extract of yellow wood of Cuba, twenty grammes; and ten grammes of alum.

Boil the ingredients as above, and then add carefully (by means of a wooden spoon, and keeping at a certain distance) as many drops of acid sulphite of indigo (Saxon blue) as may be necessary to give tone of color desired. To ascertain the depth of color pour a few drops upon white paper, or dip a piece of dry plaster of Paris in the solution. For a blue color dissolve alum, ten grammes; acid sulphite of indigo, twenty grammes, in eight liters of water until the desired color is obtained.

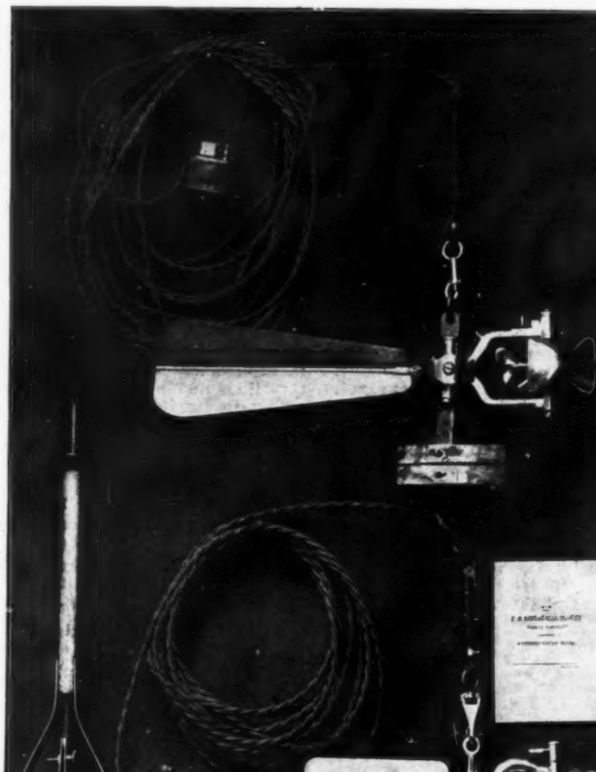
As all the varied colors of aniline penetrate the stone perfectly, they may be used at pleasure. It is only necessary to dissolve the color selected in a little alcohol, which is afterward diluted with warm water, in which alum is dissolved in the proportion of twenty-four grains of alum to every liter of water. The solution of alum may be even stronger; this is for colors which are insoluble in water. For such aniline colors as are soluble in water no alcohol is necessary. They may be dissolved in boiling water in which a little alum or sulphate of magnesia is introduced. Care must be taken to select only those colors which are durable. The same colors which are permanent in cloth are permanent in stone, and in general the same rules which apply to the art of dyeing cloth may be applied to the art of dyeing stone.

After the objects have been taken out of their respective baths they are allowed to dry, during which process the work may be retouched if necessary. When dry they are reduced to a fine surface by means of pumice stone, after which a still finer surface may be given by means of a piece of slate, or, still better, of lead, and then they may be rubbed with oil. When the oil is dry the articles may be rubbed with phosphate of lime, and the luster will be rendered perfect. The ordinary methods of polishing marble will apply to the polishing of petrified marbles prepared by the above improved process.

METHODS OF MEASURING VELOCITY IN RIVER CHANNELS.*

By H. A. Pressey.

There are in common use a number of methods of measuring the flow of rivers. In general these involve the determination of the mean velocity of the current and the area of the cross section of the stream. The latter is easily computed from soundings made at frequent intervals across the channel. These soundings must be taken at intervals so short that the bottom of the river may be considered a straight line between soundings. Usually the velocity of the current is determined in sections of the river channel, the sections extending between the points of soundings. The summation of the area of each section gives the total area of the cross section. When the total flow of the river is known and is divided by the area of the cross section the result is called the mean velocity of the river. It is this mean velocity that we try to determine in any method of stream measurement, but, as a matter of fact, it can not be actually determined until the total flow is known.



PRICE ELECTRIC CURRENT METERS.

FLOATS.

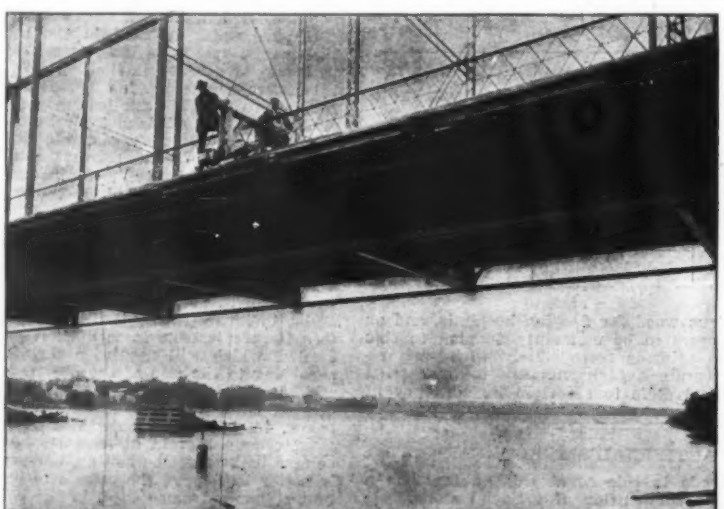
General Methods.—Floats are frequently employed to determine the velocity of the current. There are three general types in common use: First, surface floats; second, subsurface or double floats; third, tube or rod floats. The general method of procedure is the same whichever form of float is used. The site for making a float measurement should be on a straight reach, having a fairly uniform cross section. The flow of the water should be regular, without sudden rapids or stretches of still water, and should exhibit no tendencies to form eddies or cross currents caused by irregularities in the channel or resulting from the effect of a sharp bend above the reach. The course of the floats should have a length of from 100 to 300 feet, and the areas of cross section at the upper and lower ends of this course should be carefully determined by soundings. When courses more than 100 feet in length are selected, it is desirable that additional cross sections, at equal intervals from one another, should be measured. As a preliminary step, a base line should be laid out by tape on the bank as nearly as possible parallel with the stream, and points should be marked opposite the cross sections to be used. If the stream is not too wide the soundings in the cross sections can be taken most conveniently along a tagged rope stretched across the channel at right angles to the base. If the depth does not exceed 4 feet this can be done by wading, the depth being read on a rod graduated to feet and tenths. Should the depth of the channel or the temperature of the water make wading impossible, a boat may be used. On large rivers, where a tagged rope cannot be employed, the boat from which the soundings are to be made should be located by simple triangulation. Soundings should be read to tenths of a foot and be taken preferably at equal distances apart. In deep rivers a tagged rope or chain with lead weight can be substituted for the rod.

Surface Floats.—In reconnaissance work, in which the equipment is as a rule limited by transportation facilities, surface floats consisting of chips will be found most convenient. The use of rod floats, though giving more directly the mean velocity, has many disadvantages, and should not be attempted unless the time and opportunity permit of obtaining floats of the required lengths. In the simplest case but one man is needed to make the observations. The surface floats should be thrown into the stream a considerable distance above the first cross section. The hydrographer should attempt to start the floats, successively, at different distances from the shore, in order to determine the velocity in different parts of the channel. The time of the passage of each float between the upper and lower cross section should be noted, preferably by a stop watch, and also the position of each float with respect to the tags on the ropes. This will enable the hydrographer to determine whether or not he succeeds in covering the different parts of the stream, and it will serve as an aid in the computation. The observations should be continued until all parts of the stream have been covered.

On wide rivers range poles may be established on opposite shores to mark the upper and lower cross sections. The location of each float as it crosses these imaginary lines can readily be recorded by triangulation. A light traverse plane table will be found especially useful in obtaining a graphic record.

The surface floats show approximately the surface velocity of the stream at the point of measurement. The results obtained by this method are subject to errors due to wind and surface currents and eddies. The velocity shown is that of the surface of the river, while that required for computation of discharge is the mean velocity of the cross section. Unfortunately, the relation of the surface to the mean velocity of the vertical is not constant, yet for streams of the same general character of bed, banks, velocity, etc., the ratio is sufficiently constant to allow the mean velocity to be computed with fair precision from the surface velocity observations.

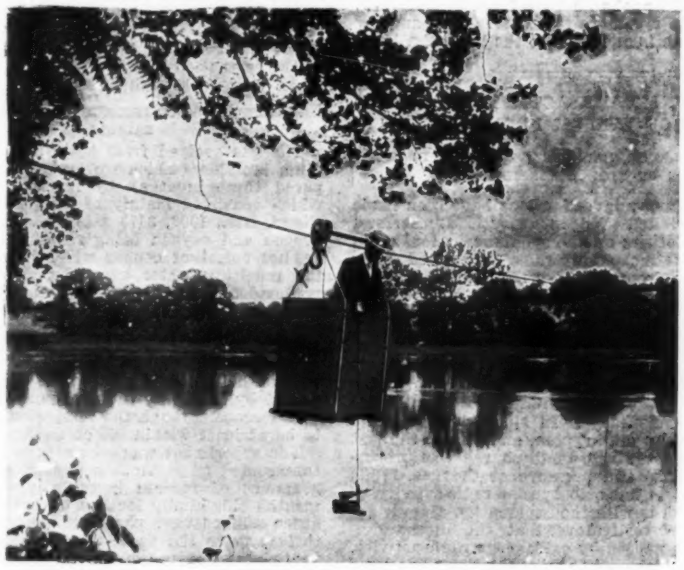
Subsurface or Double Floats.—The double float consists of a small surface float connected by a fine cord to a larger subsurface float, which is so arranged that it shall always remain at the point of mean velocity in the current. The surface float may consist of a



CURRENT METER IN USE, SUSPENDED FROM A BRIDGE.

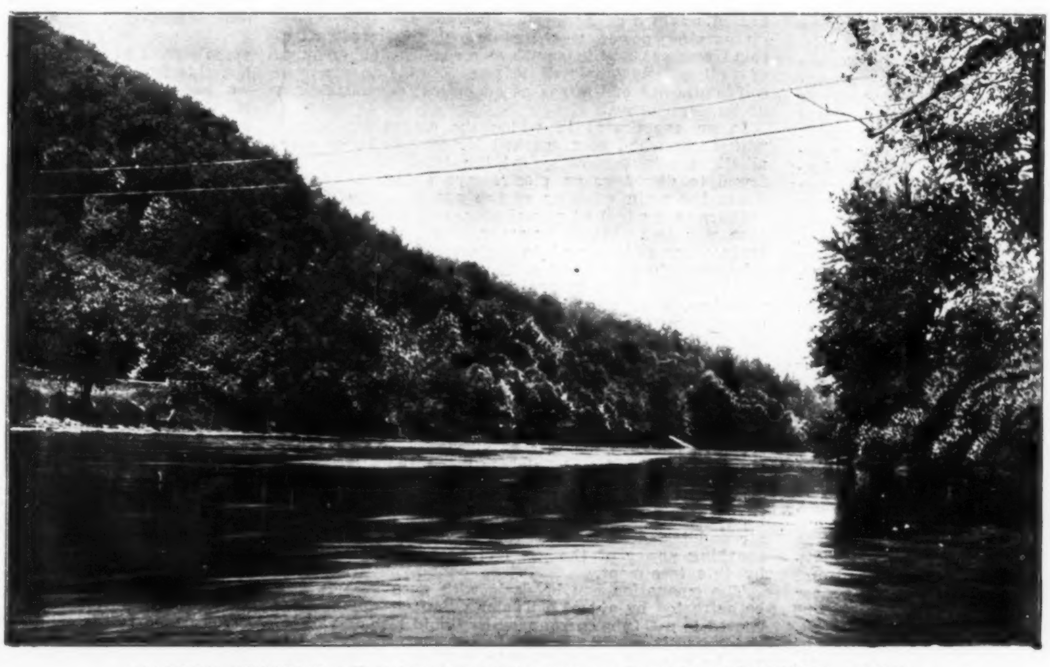
* Abstract from a monograph entitled "Observations on the Flow of Rivers," published by the United States Geological Survey.

flat block of wood or a tin water-tight drum, which floats upon the surface of the water with sufficient buoyancy to prevent the larger subsurface float from sinking. The subsurface float may consist of two sheets of galvanized iron set at right angles, weighted at the bottom, with an air-tight cylindrical device at the top, in order that it may at all times keep its vertical position. A round, hollow cylinder of tin also makes an excellent subsurface float. The tension on the connecting cord should be at least 2 or 3 pounds,



CABLE AND CAR USED TO MEASURE DISCHARGE OF RIVER.

and the cord should be of silk and as fine as possible in order that its resistance to the current should not have a marked effect upon the velocity of the floats. The length of the cord should be so regulated that the lower float may be at the point of mean veolcity, and the resistance of the upper float and the cord should be made as small as practicable. A small flag should be placed upon the upper float in order that its position may be easily determined at all times. The chief objection to double floats is the uncertainty as to whether the cord is vertical and the consequent uncertainty as to the position of the subsurface float. Another objection is the modifying effect of the surface float and the cord upon the velocity of the lower float, as in great depth the exposed surface of the cord may exceed that of the float. A third objection is the uncertainty as to the vertical position of the lower float, as, owing to changes in depth of water and local conditions, the point of mean velocity may change, whereas the length of the connecting cord must remain constant in each run. This may introduce a noticeable error if the increase in depth is large, as the retarding effect of the slow velocity near the bottom of the river will not be felt by the float, and the result will show too high a velocity. The lower float may tip slightly, owing to eddies or other causes, thereby changing the exposed surface, or, unknown to the observer, the



GAGING STATION ON HOUSATONIC RIVER AT GAYLORDSVILLE, CONN.

lower float may strike a bowlder, causing its velocity to be checked. In many cases these objections would not be at all serious, but, in general, when floats are to be used better results can be obtained, when the depth is not too great, by the use of rod or tube floats.

Rod or Tube Floats.—These consist of long, cylindrical tin tubes or wooden poles, 2 or 3 inches in diameter, weighted at the bottom, so that they will float vertically with only 2 or 3 inches exposed above the water surface. These rods integrate the velocities in a vertical section and give approximately the mean velocity of the current. It is important that they should extend nearly to the bottom, as otherwise the velocity, as shown, will be too great, yet the greatest care must be taken that they do not at any time scrape upon the rocks at the bottom or sides so as to retard their movement. Rod floats are free from many of the objections to double floats, as there is no uncertainty as to their position nor as to the point of mean velocity in the channel. They are not, however, suitable for very deep rivers, or for channels where the depth varies considerably, or where weeds grow in the bed of the stream. Mr. James B. Francis has stated that the rod floats travel a little faster than the mean velocity of the water even for the depth of immersion. The float will be subject to pressures proportional to the square of the relative velocities of the water at different points, and when it has attained its full speed there will be equilibrium between these different pressures. This equilibrium may exist, however, when the speed of the float is somewhat different from the mean velocity of the water, the latter being the arithmetical mean of all the different velocities throughout the depth of immersion. The following formula for correcting an observed velocity was derived by James B. Francis from his Lowell experiments:

$$V_m = V_o\left[1 - .116\left(\sqrt{\frac{d-d'}{d}} - 0.1\right)\right]$$

Where V_m is equal to true mean velocity in vertical, V_o equals observed velocity of tube, d equals mean depth along path of tube, d^1 equals depth of immersion of tube.

Col. Allan Cunningham* has, however, calculated that such floats move somewhat slower than the water in which they are immersed. The error of assuming that the velocity of the tube represents the mean velocity in the vertical will not be material unless tubes too short are used, in which case the velocity as shown by the tube should be somewhat reduced.

WEIRS.

By the method of weirs the discharge of the stream is computed by means of an empirical formula, which varies for different types of dams or weirs. On creeks or small rivers it is sometimes practicable to build a timber weir across the channel, causing the total flow of the stream to pass over the sharp edge of the weir crest. By observing the head on the weir, computations of the flow can be made. This is probably the most accurate method applicable to small streams. On large rivers, however, the cost of a weir is usually so great as to be prohibitive, so that if there is not a weir or dam already in the stream it is necessary to resort to measurements by floats or current meters.

On many of the rivers of moderate size the conditions are unfavorable for successfully applying either of these methods. For instance, on streams used for manufacturing purposes dams occur at frequent intervals, interrupting the regular flow, and in many cases holding back the night flow for use during the following day, so that the discharge during the night may be either nothing or a very small percentage of the day flow. Then, too, the shutting down of the mill wheels for an hour at noon may have a pronounced effect upon the results of floats or meter measurements made below the mill. Unfortunately these variations are not always apparent to the hydrographer, and surprise and annoyance are caused by finding that the river height differs by several tenths from the gage as read by the regular observer a short time before the hydrographer arrived at the station.

Under the conditions described, better results can undoubtedly be obtained if there exists upon the stream a good dam which can be used as a weir. It should have a level, even crest and a constant cross section, with sufficient pondage to reduce the velocity of approach, and it should be free from leakage. Masonry dams are better for this purpose, for they are more likely to be tight and to have an even crest. Timber dams, although level when first constructed, are likely to settle at various points, thus producing an uneven crest elevation. There are, however, many good timber dams practically free from leakage and with crests sufficiently uniform for accurate work.

Having selected a dam as the proper site for a station, a careful survey must be made of the crest line and of the upper and lower slopes, so that it can be compared with other dams or with experimental sections for which the coefficients of flow are known. The experiments of James B. Francis, of Fteley & Stearns and of John R. Freeman, George W. Rafter, and others at Cornell University, have given coefficients upon many sections of various forms. It is probable that the dam selected for the station will not be exactly like any of the experimental forms, but it will resemble some of them so closely that coefficients can be selected for the computations.

When the mill gates are open a part of the flow is diverted from the river through the mill race, the gates, and the tailrace.

The amount of the diversion must of course be measured and added to the quantity flowing over the dam, in order to determine the total discharge of the stream. In many factories the quantity flowing through the wheels varies from day to day, and also during different hours of the day, so that careful records must be kept of gate openings, in order that proper allowance may be made for these variations. The size and the make of the water wheels must be ascertained, and the wheels be used as water meters for the determination of the flow through them. Many of the modern wheels have been carefully rated. Where such ratings have not been made, usually records of wheels of the same type, though possibly of different makes, can be found and the records be compared. Water wheels as meters give fairly accurate records of the discharge.

The Chezy formula or surface-slope method has been extensively employed in gaging large rivers. The proper coefficients to be applied are usually determined from the auxiliary formula of Ganguillet and Kutter. One difficulty in the application of this method lies in the selection of suitable friction factor or coefficient of roughness.

CURRENT METERS.

The current meter has been found best adapted to the general measurements made by the United States Geological Survey, and is used almost exclusively in its hydrographic investigations. Occasionally, however, either a meter is not available or the conditions are not favorable for its use. In such cases weirs or

* Recent hydraulic experiments: Min. Proc. Inst. Civil Eng., Vol. LXXI., 1883.

floats have been used, though a Pitot's tube, hydrometric pendulum, or hydrometric balance might in exceptional cases be used to advantage.

The current meter may be used to determine the velocity of a river in four ways: First, by making point measurements at a depth corresponding to the approximate position of the thread of mean velocity; second, by deducing the mean velocity from observations made at other points in the same vertical; third, by the integration method; fourth, by point measurements made at regular intervals throughout cross sections of the river. In the first two of these methods it is important to know the relation between the velocities at various points in the section. In the first method the position of mean velocity must be known, and in the second method the relation between the surface velocity, or the velocity at mean depth, to the mean velocity must be known. In either of these cases the form of the vertical velocity curve will determine the coefficient to be applied to the observations.

VERTICAL VELOCITY CURVES ON STREAMS WITHOUT ICE COVER.

Studies of the vertical velocity curve made on the Mississippi River by Humphreys and Abbott, on the Connecticut by T. G. Ellis, on the Merrimac flume by Wheeler and Lynch, on the Potomac by C. C. Babb, and recent experiments by others, notably those at Cornell University by E. C. Murphy, indicate that the point of mean velocity in a given vertical section is at a depth varying from six-tenths to two-thirds of the total depth of the section, measured from the surface down. The values found in the experiments were as follows:

DEPTH FROM SURFACE OF POINT OF MEAN VELOCITY.

Experimenter.	Stream.	Depths.
Cyrus C. Babb	Potomac River	0.58
Humphreys and Abbott	Mississippi River	.63
T. G. Ellis	Connecticut River	.64
E. C. Murphy	Cornell flume	*.65
Wheeler and Lynch	Merrimac flume	.67

* For depths between 6 and 9 feet, the proportionate depth of point of mean velocity becoming less as the depth of the water decreased, and becoming 0.55 for depths of water between 1 and 2 feet.

The Cornell experiments indicate that measurements made at six-tenths of the depth yield results 3.5 per cent too large, the depth of mean velocity being nearly two-thirds of the depth. The measurements at Cornell were, however, made in the canal, the cross sections of which have a greater ratio of depth to width than most rivers, and decidedly more than the Mississippi, Connecticut, and Potomac, upon which the above coefficients were obtained. There can be no doubt but that the difference in the ratio of the depth to width is a factor likely to affect the position of mean velocity.

The bottom and sides of the channel retard the flow close to them in proportion to their roughness, this retardation being due more to the impeding of the flow by eddies than by friction alone. The retardation of the surface velocity has been attributed to the rising, by vertical motion, of the lower water to the surface after being checked in its flow by striking against the rough bottom and sides of the channel.

Mr. Frederick P. Stearns has attributed the reduction of surface velocity to the general retarding of the layers of water adjacent to the banks of the stream, this water rising to the surface and thereby making the edges of the channel higher than the center and causing a flow of the slowly moving water from the sides toward the middle, thereby decreasing the surface velocity, depressing the point of maximum velocity, and lowering in general the filament of mean velocity. This depression of the maximum velocity is known to become more pronounced with an increase in the roughness of the lining, in the steepness of the banks, and in the ratio of depth to width. In an extreme case of a wide, shallow stream, where the bottom merges imperceptibly into the banks, maximum velocity occurs, under normal conditions, at or very near the surface of the center of the stream. On the other hand, in a deep, narrow channel, as, for instance, in a canal with vertical sides, the maximum velocity occurs a considerable distance below the surface, and, as the Cornell experiments indicate, this depression may amount to as much as one-third and even two-fifths of the total depth. Evidently, then, in such cases a depression of maximum velocity must result in a lowering of the thread of mean velocity, and engineers, in making unit measurements for mean velocity, should bear in mind that while the observations at six-tenths depth give fair values for mean velocity in wide, shallow rivers this ratio should be increased to two-thirds in the case of canals and flumes or narrow natural channels.

The friction of flowing water against the air has a similar influence, and, though in general less marked, it may, in the case of a strong upstream wind, have a decided influence upon the surface velocity and the point in the vertical of the maximum and mean velocity. On account of these resistances on the bed and bank of a stream, the maximum velocity of the river in a straight reach is found in the central portion of the stream, and somewhat below the surface—the actual position depending upon the size and condition of the river and the velocity of flow. The velocity increases from the surface downward for a short distance—say, one-tenth of the depth—and then decreases down to the bottom, where it reaches the minimum.

The mean of 78 velocity curves taken upon rivers in the southern part of New York State shows that the mean velocity was 0.87 of the surface velocity in the vertical section (shown in Fig. 3). This coefficient varied from 0.82 in the case of Catskill Creek to 0.93 in Fishkill Creek. These coefficients apply to the mean velocity in the vertical in which the float is run. If only one surface float is used, and that in the center of the river, or point of maximum velocity, it appears that 0.8 is the proper coefficient to apply, though the chances of error are much greater than when surface floats are used at intervals across the channel.

HOUSATONIC RIVER AT GAYLORDSVILLE, CONN.

A gaging station was established at Gaylordsville, Conn., October 24, 1900. The station is situated 3 miles east of the New York State line and 2 miles below the mouth of Tenmile River. Owing to the unfavorable conditions under the bridge, the discharge measurements are made from a cable of 200 feet span placed across the stream 1¼ miles below the bridge. A view of the river at this point is shown in the figure. The cable is supported on the right bank by timber shears 25 feet high and is anchored to a large buried rock. On the left bank a sycamore tree serves as a support for the cable, which is anchored to the base of a large oak.

EXPERIMENTS IN RADIO-ACTIVITY, AND THE PRODUCTION OF HELIUM FROM RADIUM.*

I. EXPERIMENTS ON THE RADIO-ACTIVITY OF THE INERT GASES OF THE ATMOSPHERE.

Of recent years many investigations have been made by Elster and Geitel, Wilson, Strutt, Rutherford, Cooke, Allen, and others on the spontaneous ionization of the gases of the atmosphere and on the excited radio-activity obtainable from it. It became of interest to ascertain whether the inert monatomic gases of the atmosphere bear any share in these phenomena. For this purpose a small electroscope contained in a glass tube of about 20 cubic centimeters capacity, covered in the interior with tin-foil, was employed. After charging, the apparatus if exhausted retained its charge for thirty-six hours without diminution. Admission of air caused a slow discharge. In similar experiments with helium, neon, argon, krypton, and xenon, the last mixed with oxygen, the rate of discharge was proportional to the density and pressure of the gas. This shows that the gases have no special radio-activity of their own, and accords with the explanation already advanced by these investigators that the discharging power of the air is caused by extraneous radio-activity.

Experiments were also made with the dregs left after liquefied air had nearly entirely evaporated, and again with the same result; no increase in discharging power is produced by concentration of a possible radio-active constitutent of the atmosphere.

II. EXPERIMENTS ON THE NATURE OF THE RADIO-ACTIVE EMANATION FROM RADIUM.

The word emanation originally used by Boyle ("substantial emanations from the celestial bodies") was resuscitated by Rutherford to designate definite substances of a gaseous nature continuously produced from other substances. The term was also used by Russell ("emanation from hydrogen peroxide") in much the same sense. If the adjective "radio-active" be added, the phenomenon of Rutherford is distinguished from the phenomena observed by Russell. In this section we are dealing with the emanation, or radio-active gas obtained from radium. Rutherford and Soddy investigated the chemical nature of the thorium emanation (Phil. Mag., 1902, p. 580) and of the radium emanation (*ibid.*, 1903, p. 457), and came to the conclusion that these emanations are inert gases which withstand the action of reagents in a manner hitherto unobserved except with the members of the argon family. This conclusion was arrived at because the emanations from thorium and radium could be passed without alteration over platinum and palladium black, chromate of lead, zinc dust, and magnesium powder, all at a red-heat.

We have since found that the radium emanation withstands prolonged sparking with oxygen over alkali, and also, during several hours, the action of a heated mixture of magnesium powder and lime. The discharging power was maintained unaltered after this treatment, and inasmuch as a considerable amount of radium was employed it was possible to use the self-luminosity of the gas as an optical demonstration of its persistence.

In an experiment in which the emanation mixed with oxygen had been sparked for several hours over alkali, a minute fraction of the total mixture was found to discharge an electroscope almost instantly. From the main quantity of the gas the oxygen was withdrawn by ignited phosphorus, and no visible residue was left. When, however, another gas was introduced, so as to come into contact with the top of the tube, and then withdrawn, the emanation was found to be present in it in unaltered amount. It appears, therefore, that phosphorus burning in oxygen and sparking with oxygen have no effect upon the gas so far as can be detected by its radio-active properties.

The experiments with magnesium-lime were more strictly quantitative. The method of testing the gas before and after treatment with the reagent was to take 1-2000 part of the whole mixed with air, and after introducing it into the reservoir of an electroscope to measure the rate of discharge. The magnesium-lime tube glowed brightly when the mixture of emanation and air was admitted; and it was maintained at a red-heat for three hours. The gas was then washed out with a little hydrogen, diluted with air and tested as before. It was found that the discharging power of the gas had been quite unaltered by this treatment.

The emanation can be dealt with as a gas; it can be extracted by aid of a Töpler pump; it can be condensed in a U-tube surrounded by liquid air; and when condensed it can be "washed" with another gas which can be pumped off completely, and which then possesses no luminosity and practically no discharging power. The passage of the emanation from place to place through glass tubes can be followed by the eye in a darkened room. On opening a stop-cock between a tube containing the emanation and the pump, the slow flow through the capillary tube can be noticed; the rapid passage along the wider tubes; the delay caused by the plug of phosphorus pentoxide, and the sudden diffusion into the reservoir of the pump. When compressed, the luminosity increased and when the small bubble was expelled through the capillary it was exceedingly luminous. The peculiarities of the excited activity left behind on the glass by the emanation could also be well observed. When the emanation had been left a short time in contact with the glass, the excited activity lasts only a short time; but after the emanation has been stored a long time the excited activity decays more slowly.

The emanation causes chemical change in a similar manner to the salts of radium themselves. The emanation pumped off from 50 milligrammes of radium bromide after dissolving in water, when stored with oxygen in a small glass tube over mercury turns the glass distinctly violet in a single night; if moist the mercury becomes covered with a film of red oxide, but if dry it appears to remain unattacked. A mixture of the emanation with oxygen produces carbon dioxide when passed through a lubricated stop-cock.

III. OCCURRENCE OF HELIUM IN THE GASES EVOLVED FROM RADIUM BROMIDE.

The gas evolved from 20 milligrammes of pure radium bromide (which we are informed had been prepared three months) by its solution in water and which consisted mainly of hydrogen and oxygen (cf. Giesel, Ber., 1903, 347) was tested for helium, the hydrogen and oxygen being removed by contact with a red-hot spiral of copper wire, partially oxidized, and the resulting water vapor by a tube of phosphorus pentoxide. The gas issued into a small vacuum-tube which showed the spectrum of carbon dioxide. The vacuum tube was in train with a small U-tube, and the latter was then cooled with liquid air. This much reduced the brilliancy of the CO_2 spectrum, and the D_3 line of helium appeared. The coincidence was confirmed by throwing the spectrum of helium into the spectroscope through the comparison prism, and shown to be at least within 0.5 of an Angström unit.

The experiment was carefully repeated in apparatus constructed of previously unused glass with 30 milligrammes of radium bromide, probably four or five months old, kindly lent us by Prof. Rutherford. The gases evolved were passed through a cooled U-tube on their way to the vacuum-tube, which completely prevented the passage of carbon dioxide and the emanation. The spectrum of helium was obtained and practically all the lines were seen, including those at 6677, 5876, 5016, 4932, 4713, and 4472. There were also present three lines of approximate wave-lengths, 6180, 5695, 5455, that have not yet been identified.

On two subsequent occasions the gases evolved from both solutions of radium bromide were mixed, after four days' accumulation which amounted to about 25 cubic centimeters in each case, and were examined in a similar way. The D^3 line of helium could not be detected. It may be well to state the composition found for the gases continuously generated by a solution of radium, for it seemed likely that the large excess of hydrogen over the composition required to form water, shown in the analysis given by Bodländer (Ber., *loc. cit.*) might be due to the greater solubility of the oxygen. In our analyses the gases were extracted with the pump, and the first gave 28.6, the second 29.2 per cent of oxygen. The slight excess of hydrogen is doubtless due to the action of the oxygen on the grease of the stop-cocks, which has been already mentioned. The rate of production of these gases is about 0.5 cubic centimeter per day for 50 milligrammes of radium bromide, which is more than twice as great as that found by Bodländer.

IV. PRODUCTION OF HELIUM BY THE RADIUM EMANATION.

The maximum amount of the emanation obtained from 50 milligrammes of radium bromide was conveyed by means of oxygen into a U-tube cooled in liquid air, and the latter was then extracted by the pump. It was then washed out with a little fresh oxygen, which was again pumped off. The vacuum tube sealed on to the U-tube, after removing the liquid air, showed no trace of helium. The spectrum was apparently a new one, probably that of the emanation, but this has not yet been completely examined, and we hope to publish further details shortly. After standing from July 17 to 21, the helium spectrum appeared, and the characteristic lines were observed identical in position with those of a helium tube thrown into the field of vision at the same time. On July 22 the yellow, the green, the two blues, and the violet were seen, and in addition the three new lines also present in the helium obtained from radium. A confirmatory experiment gave identical results.

We wish to express our indebtedness to the research fund of the Chemical Society for a part of the radium used in this investigation.

* By Sir William Ramsay, K.C.B., F.R.S., and Mr. Frederick Soddy. Received at the Royal Society July 28.

CAUSES OF EXPLOSION OF ACETYLENE AND MEANS OF PREVENTING THEM.

The density of acetylene is 0.91; its solubility in water, 110 volumes; in salt water, 6 volumes; temperature of ignition under atmospheric pressure, 480 deg. C.; critical temperature, 37 deg. C. under pressure of 67 atmospheres; heat of combustion, 14,340 calories to the cubic meter, or 12,200 calories to the kilogramme.

Under a pressure of less than two atmospheres, the gas will not explode on contact with a red-hot body or a lighted match, but under a stronger pressure, the explosion is produced.

Mixtures of air and acetylene containing from 25 to 65 per cent of acetylene explode at 480 deg. C. on contact with an open flame.

According to the experiments of Lewess, if, in order to produce acetylene, water is poured in very slight streams on the carbide, the latter becomes heated, and its temperature may attain 807 deg. C.; if, on the contrary, water is poured on in great quantity, the temperature rises only to 66 deg. C. It is certain that the impurities contained in acetylene may modify these figures and increase the danger of explosion of the gaseous mixture. On this account, phosphoreted and sulphureted hydrogen especially ought to be eliminated, as well as ammonium, which with the copper of the apparatus forms explosive cupric acetylide. Phosphoreted and sulphureted hydrogen are prevented, at least in dangerous quantities, by employing as original material lime of good quality, free from phosphorus and sulphur.

From these observations the following rules may be deduced, which ought to be observed in constructing

apparatus for acetylene and in the preparation of this product:

1. Employment of as pure a carbide as possible.
2. Addition of water to the carbide in great quantity.
3. Purification of the acetylene to prevent the forming of complex gases.
4. Elimination of air in the apparatus producing acetylene.
5. Construction of acetylene apparatus with other substances than copper and its alloys.
6. Absence of every other source of heat.
7. Tight closing of all acetylene apparatus, pipes, etc., careful supervision of the pipes conveying acetylene; only cast-iron pipes should be employed, or pipes of materials sufficiently thick to resist the pressure of the gas. The joints between the pipes must be of good quality; pipes as long as possible ought to be used.

The "thermite" of Dr. Goldsmith furnishes an excellent medium for soldering tubes together. It has been employed successfully in several Swiss establishments.—Translated from Acetylen in Wissenschaft und Industrie.

THE FUTURE OF COAL GAS.*

WHEN, in the early years of last century, coal gas became a commercial reality, the one end and aim of the manufacturer was to produce his gas, and such details as purity, illuminating and calorific value never troubled his mind. As time passed on, however, and competing companies vied with each other in their endeavors to secure customers, advantages had to be offered to coax consumers from the enemy's camp, and those who remember the battle of the two then existing city companies with another proposed rival in 1847-48-49, and the way in which the gas consumers in the city were at that time pestered and pamphleted by the supporters of the rival schemes, will realize that even in those days gas management was not a bed of roses. The outcome of the rivalry was the introduction in the early fifties of a standard of illuminating value, and a string of parliamentary requirements which have ever since safeguarded the consumer and harried the gas manufacturer.

In 1850 a bill was passed which enacted that a consumption of 5 cubic feet of gas per hour should be equal to the light of twelve wax candles of the size known as sixes, the burner employed being a brass Argand burner with fifteen holes. In 1860 another act changed the illuminating power to twelve sperm candles, which meant an increase of some 16½ per cent in the illuminating value of the gas, owing to the fact that the wax candles originally used were only equal in illuminating power to 10.3 sperm candles, as at present employed for testing purposes. In 1868 the illuminating power was again raised to fourteen candles, while, in 1876, the present sixteen-candle standard was reached.

The amount of light emitted, however, by the gas was still insufficient to satisfy the desires of the consumers, who, utterly ignoring the fact that the illumination to be derived from coal gas was quite as much dependent on the burners employed as it was upon the standard illuminating value, vented their dissatisfaction at the light emitted by small flat-flame burners by clamoring for a higher quality of gas; and even thirty years ago the great aim of the gas-consuming public was to obtain the highest candle power that could be squeezed out of the gas company, in order that they might gain something like decent illumination from the flat-flame burners then almost exclusively used, and which were, as a rule, so small as to destroy entirely the value of the gas. It was at this period that the anomaly became common of seeing a town supplied with gas of more than twenty-candle illuminating value swathed in semi-darkness, while another, using the much-abused thirteen or fourteen-candle gas, supplied at a good pressure and burned in decent-sized burners, was well illuminated.

It was at this time, also, that some of our most able chemists ranged themselves on the side of the votaries of high illuminating power, and even such practical-minded men as the late Sir Edward Frankland clamored for the introduction of high illuminating power gas, such as is produced from cannel, in place of sixteen-candle coal gas, the general line of argument being well shown by portions of Sir Edward Frankland's introduction to the section of his published researches dealing with applied chemistry, in which such paragraphs as the following occur:

"Coal gas is not suitable for use in dwelling houses by reason of its very low illuminating power—100 cubic feet of coal gas containing only 4 cubic feet of illuminating gas; the rest is mere rubbish, which heats and pollutes the air in which the gas is consumed. . . . It cannot be too widely known that coal gas, although it costs less per 1,000 cubic feet, is, light for light, much dearer than cannel gas." †

Even now, when altered circumstances make a high-power gas an anything but desirable and economical supply, there are not wanting advocates who, undaunted, or perhaps ignorant of the practical side of the question, still try to bolster up the old idea.

It was in the latter part of the eighties that the lot of the worried manager was made even harder by the rise in price taking place in cannel coal, on which, up to that time, he had entirely relied in admixture with ordinary gas coal to give those higher grades of illumination demanded by the fashion of the time, and which, although it ruined his coke, yet proved an efficient and trustworthy servant.

This increase in price became so serious that in 1889 the Gas Light and Coke Company commenced experiments which led to the introduction of carbureted water gas in place of cannel as an enricher, this process proving itself a most valuable addition to the manufacture of coal gas, and rapidly gaining favor and popularity, not only as giving an easy means of raising the candle power of poor coal gas, but also as a stand-by in case of any sudden calls upon the production power of the works.

About this same period also, another method of enrichment was introduced, which consisted of adding to gas which did not fulfill the parliamentary requirements the vapors of such highly volatile hydrocarbons as petroleum spirit and benzol, which, on account of their high illuminating value, gave the necessary increase in the candle power by the addition of an amount of vapor not likely afterward to recondense from the gas.

While these changes were taking place in gas manufacture, rivals which seemed to threaten its very existence had forced their way to the front, and with the electric light largely used by the rich, and petroleum reduced to a price at which even the poorest could afford its use as an illuminant, the field of utility seemed to be rapidly disappearing from beneath the feet of the gas industry. However, when things were looking their blackest, there slowly struggled into prominence and commercial success a factor which at once restored gas to its position of primary importance.

It was in 1885 that the researches of Dr. Auer von Welsbach culminated in the production of the incandescent mantle, which, frail and unsatisfactory in its earlier forms, was gradually so improved in composition and manufacture that by 1892 it became a brilliant commercial success, and placed in the hands of the gas industry a weapon which rendered its position unassailable in competition with electricity.

Looked at from a common-sense point of view, the incandescent mantle will be seen to be merely a method of enrichment. Instead of increasing the illuminating power of a flame by crowding into the gas more and more hydrocarbons, which during combustion are capable of separating carbon particles, the incandescence of which would increase the amount of light emitted by the flame and *pro rata* the amount of heating and vitiation, with the mantle you charge the flame with incombustible particles of far greater light emissivity than the carbon possesses, and they do their work without that increase in the temperature and fouling of the atmosphere inseparable from the other processes. It is the introduction of the incandescent mantle and the improvements which are possible in its construction which really give the possibilities to the gas of the future.

Taking the enriched gas as supplied during the nineties, the light which can be obtained from it is entirely dependent upon the burner in which it is consumed. This may be stated as follows:

Light emitted per cubic foot of sixteen-candle gas consumed.

Burner.	Candle units.
Incandescent—high pressure	30 to 35
" —Kern	20 to 25
" —ordinary	14 to 19
Regenerative	7 to 10
Standard Argand	3.20
Ordinary Argand	2.90
Union jet flat flame No. 7	2.44
" 6	2.15
" 5	1.87
" 4	1.74
" 3	1.63
" 2	1.22
" 1	0.85
" 0	0.59

In considering the value given to the gas by these burners, it is seen that, according to the method by which it is burnt, the consumer may obtain anything from thirty-five candles down to less than one candle per cubic foot of gas. It must also be borne in mind that the burners employed in these tests were all good, well-made burners, giving the best duty that can be obtained from them, while an examination of burners used in consumers' houses shows that in most cases any antiquated and corroded burner is considered good enough at which to burn the gas, and the very people who are loudest in their complaints as to the quality of the gas are those who most disregard the method of its consumption.

England is far behind Germany in the use of incandescent lighting, and an inquiry made into the uses to which the coal gas supply of a large town was put gave the following result:

	Per cent.
Incandescent lighting—private	12.00
Incandescent lighting—public	6.25
Cooking	22.65
Gas engines	6.60
Used in other ways	52.50
	100.00

So that 47.5 per cent is used for purposes in which illuminating power is of no use and calorific effect is the one important factor.

It is also seen that 18.25 per cent of the total gas made is used for incandescent lighting, and this represents about 23 per cent of the gas used for illuminating purposes, as against 90 per cent used in this way in Germany.

This 23 per cent thus used gives for a consumption of five cubic feet not less than seventy candles, while the average light obtained by the combustion of the remaining 77 per cent is 8.5 candles.

It is quite clear that under such conditions as these the supply of gas of a high candle power is simply waste of money, and it is manifestly unfair that the consumer of average intelligence, who is willing to utilize the benefits given by the incandescent mantle, should have to pay for a quality of gas only rendered necessary by the inertia of those who decline to march with the times.

Coal gas is daily being used more and more as a fuel, and although the slight diminution of calorific value which must of necessity accompany a lowered illuminating value is a slight drawback, yet in practice any desired temperature can be attained by a slightly larger consumption. Also a cheapening of the gas would induce many to adopt it as a fuel, this in turn tending to level up the load in production, and so to render more economies possible.

Everything clearly points in one direction, and that is, that the future of coal gas is entirely dependent upon a plentiful supply of low-grade gas—low grade from the point of view that it should only have an illuminating value of ten to twelve candles, that its heating value shall be as high as can be practically attained and that its price shall be as low as is consistent with the interests of the consumers as well as of the shareholders in the gas industry.

Already the stream has set in in this direction, and the lowering of the Parliamentary standard of sixteen to fourteen candle power in the case of the South Metropolitan, Commercial, and West Ham Companies will soon be followed by many companies now saddled with a higher standard than fourteen candles seeking relief. That relief cannot in fairness be refused, while experience of the benefits conferred by the reduction will soon lead to the further step that will place gas manufacture in this country on the same advanced footing that it has already gained in the most progressive cities in Germany.

In making low-grade gas of this character, several processes may be employed, but probably the most economical is to utilize water gas as an aid to the distillation of the coal in the retorts, the proportion of water gas so used being kept down to a point at which the carbon monoxide in the finished gas shall not exceed 16 per cent.

The cheapening in mantles which is now taking place, together with improvements in their manufacture which will give an increased length of life and light, promises a great extension in the use of gas for this purpose.

Another direction in which the future of coal gas will benefit largely, by a cheapening in price owing to economies in manufacture and distribution, will be for use as a fuel. Already the ever-increasing demand made upon the metropolitan companies during the day marks the advance of the utilization of coal gas for cooking, heating, and power, so that while the increase in the amount of gas used at night is only rising by some 3 per cent annually, the day consumption shows an increase of 16 per cent. Directly it becomes possible to reduce the price of gas to about 2s. a thousand, advance on these lines will become extremely rapid, and the gas companies are naturally doing everything in their power to foster this development. It is, however, necessary, in order further to popularize gas as a fuel, that everything that can be done should be done to remove any prejudices that exist against heating by gas.

There are many excellent gas stoves on the market, well designed, and giving high heating duty for the gas consumed, but there are also many that, both in their performance and their effect upon the atmosphere, are radically bad. Now that the gas companies have so largely taken over the sale and pushing of gas-heating apparatus, it is a duty they owe to themselves and to their customers to take care that only stoves of scientific construction and good efficiency should be supplied. Many of the worst stoves are the most ornate, and for that reason find their way into many homes, as they, in the first place, appeal to the eye of the housewife, and afterward to the nose and health of the household, the result being that a good customer is converted into an enemy of gaseous fuel. No gas fires should be sold or let on hire that do not do a large proportion of the heating by radiation, and a gas company that sells a flueless gas stove, save for hall or passage heating, should be prosecuted.

A cubic foot of coal gas on its complete combustion yields 0.52 cubic foot of carbon dioxide and 1.30 cubic feet of water vapor, and if you do not mind breathing hot polluted air highly charged with water vapor, and getting chilled with cold walls, a Bunsen burner stood on the floor is the most effective method of getting the whole of the heat of combustion into the air of the room, and no flueless stove can do more than this. In order to get something to sell, stoves are constructed in which some of the water is condensed, and the public are gravely informed that this removes all deleterious products. But it is impossible to get away from the fact that if healthful heating is to be obtained, it is the solid objects and walls of the room that must be heated, and not the air, and that although some of the heat is lost thereby, a flue to take off all products is an absolute essential.

The gas companies have it in their power to govern the gas-stove trade, and unless they choose to take the initiative, it will retard the popularity of heating by gas to a most serious degree. With all stoves in which solid bodies like asbestos are heated by atmospheric burners, a trace of carbon monoxide is always produced, and if there is not a proper flue passing well into the chimney, a headache is added to the other discomforts.

Improvements in gas motors and gas engines are steadily going on, and as soon as the price of coal gas can be reduced sufficiently to attract this class of custom, a wide field will be opened up for it.

The development of large gas engines during the last few years gives promise of an entire revolution in our methods of procuring power, and it is highly probable that within a very few years the gas engine will make great inroads upon the generation of power by steam. Already gas engines up to 1,500 horse power have been constructed while engines of more than double that power are under construction.

In England, Messrs. Crossley Brothers and other well-known makers are producing a very large number of such engines for driving dynamos, while it is stated that on the Continent Messrs. Korting Brothers have made, or have under construction, thirty-two gas engines, with a total of 44,500 horse power, averaging 1,390 horse power each engine, and the John Cockerill Company and several German companies follow not far behind.

With such a development of gas for motor purposes, it is manifestly the policy of the gas companies to make a determined bid for so wide a field of output, and if they can supply a clean heating gas with 460 to 500 B. T. U.'s heating power, it is clear that the convenience of doing away with separate generating plant would cause a large proportion of this business to fall to their share, if the price of the coal gas could be made to compete with a fuel gas, that is to say, if nearly the same number of thermal units could be obtained by its use at the same cost.

Gas fittings should be entirely taken over by the gas companies, which should supply incandescent fittings and mantles and keep them in order at a small yearly rental; and where swinging brackets and other causes

* Abstract of Cantor lectures delivered at the Society of Arts by Prof. V. B. Lewes.

† Frankland's "Experimental Researches in Pure, Applied and Physical Chemistry," 1877, p. 488.

demand flat-flame burners, the companies should fit nipples with broad slits regulated to burn at the lowest possible pressure.

Everything at the present time points to the gas of the future being a twelve-candle power gas, with a calorific value of not less than 460 B. T. U.'s net and a selling price of not more than 2s. a thousand, the economies necessary to reach this lower price being brought about by making the gas in the holders at 9d. to 9½d. a thousand and distributing it at a considerably increased pressure, the pressure being regulated down to 1½ inches at the entrance to the consumer's meter.

AN AUTOMOBILE SUPPORTED BY A MAN.

THE Moulin Rouge, which has recently been converted into a luxurious music hall, is inviting the public to come every evening to witness the "crushing" of a man by an automobile. Let our readers not get excited, however, for the victim of this accident daily undergoes this experience without harm, and there are no limbs broken and no spilling of blood. On the contrary, the attraction is merely an athletic spectacle, which is something novel, and calculated to attract the public. The name of the voluntary "crushed" person is Lionel Strangfort, who was born in Berlin and is twenty-three years of age. He is one of the most wonderful athletes that we have been permitted to see since Sandow, and one who seems to have discovered the secret of combining within himself muscular power and plastic beauty. By wise and judicious training, this man has succeeded in acquiring the faculty of using his powerful muscles to the fullest extent. When from the darkness at the back of the stage his figure stands out in the glare of the electric searchlights, we might imagine that we were gazing upon one of those beautiful statues of athletes that have been left to us by Greek art.

This is the first time that Strangfort, who up to the present has been giving exhibitions in America, has been seen in France. He is a pupil of Attila, who also is a fine athlete, and who appeared upon the stage of the Folier-Bergère a few years ago. Attila founded in New York a school of physical culture, which was highly successful and was frequented by members of the best society in that city. Thanks to a peculiar system of training, which is known in France by the name of the "Sandow" method, Attila succeeds in forming strong and harmonious and well-muscled men out of weak and spare and even sickly ones. As an illustration of the excellence of the method, it suffices to mention the two wonderful athletes that it has formed —Sandow and Strangfort.

Strangfort precedes his exercises by a series of plastic poses in which he displays the exceptional relief of his muscular system. He possesses, in fact, the faculty of making his muscles play as if they were independent of each other, and shows us, so to speak, a cascade of muscles such as it is not often permitted us to witness. The muscles of his forearms and thighs contract and then expand without a motion of the limbs. His biceps rise up to the shoulder and then descend to the elbow. His thorax takes on an extraordinary amplitude while his abdomen becomes sunken and incurved. The muscles of his back roll in balls that rise and descend at his will as if moved by invisible springs (Fig. 1). Such independence of the muscles is the most remarkable and characteristic feature of the repertoire of this athlete, who has been justly surnamed the "King of the Muscles." We give the following measurements of Strongfort's body as a matter of curiosity: Height, 5.75 feet; neck, 16 inches; chest, 3.8 feet; girth, 33 inches; forearm, 13 inches; wrist, 7 inches; biceps, 16 inches; thigh, 25 inches; calf of the legs, 16 inches.

Strangfort afterward goes through a series of strength-demonstrating exercises, upon which we shall not expatiate. With his powerful fingers, he tears as many as six packs of cards, as if it were a question of a package of cigarette paper. He finally terminates his exhibition with the exercise in "crushing." The term "crushing" is here improper, since the athlete, without appearing to be incommoded and without weakening, withstands the passage over his body of a 1,760-pound De Dion & Bouton automobile containing three persons, say a total weight of about 2,200 pounds. Strangfort rests upon the stage on his hands and feet facing upward, and with his body bent in the shape of an arch. Upon his knees and shoulders is placed a heavy apparatus in the form of a bridge, consisting of large beams, and recalling a see-saw. It is a sort of wide platform capable of oscillating to the right and left upon an axis resting upon the athlete's body. This platform is secured on each side to a wooden incline having an inclination of about 8 to 100. The automobile with its three passengers moves slowly up one of the inclines and runs over the platform of which Strangfort forms the living support. After it has passed beyond Strangfort's body, the vehicle, through its own weight, causes the platform to tilt upon the opposite side, and then descends rapidly and reaches the second incline, as shown in Fig. 2. It will be admitted that it takes an uncommon power of resistance to support (were it but for four or five seconds) a weight of 2,200 pounds rolling over the body, and that, too, when having merely the hands and feet as points of support.—Translated from La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

FIG. 1.—LIONEL STRANGFORT IN HIS POSES.

FIG. 2.—STRANGFORT SUPPORTING THE WEIGHT OF A 2,200-POUND AUTOMOBILE.

FUELS OTHER THAN COAL AND WOOD.

COAL at fancy prices has stimulated geniuses all over the world, apparently, to finding substitutes for it, and all kinds of makeshifts for coal have been placed on the market. S. O. Edison, East Orange, N. J., proposes to convert the natural or dried fibers of all kinds of grasses, grain, corn, sugar cane, etc., into artificial fuel, and he has obtained a patent on the process for treating such materials by which he claims to be able to produce a smoldering flame similar to that resulting from burning coal instead of a blaze caused by the ignition and consumption of wood. In brief, his plan is to cook straw or other grasses in a moist heat until the fibers are softened, but have not lost their identity, and then presses them into combustible blocks.

A Philadelphia man has a patent on a plan to make a combustible briquette from comminuted coal, coke or other burnable material by the use of molasses as a binding agent. Another scheme is for making lignite available as a high-grade fuel. If the scheme of a Baltimore man for making fuel out of sawdust should be found practical the coal problem would be solved, at least in the vicinities where saw mills are kept busy the year round. He has invented machinery for separating by centrifugal force the particles or grains of dust, which are simultaneously exposed to the action of heated gases to vaporize and remove the volatile matter. The sawdust particles are then carbonized and pressed into shape for consumption in grates, stoves and furnaces.

A prescription for compounding fuel has been drawn up by a resident of Fort Worth, Tex., and he claims the product is superior to the best grade of bituminous coal and at the same time is far cheaper. In addition to all these advantages he calls attention to the fact that it possesses the highly desirable quality of being non-explosive. His formula calls for the admixture of the following ingredients: Crude petroleum, 18¾ per cent; rosin, 2½ per cent; sawdust, 12½ per cent; clay, 12½ per cent; liquid glass, 2½ per cent, and lignite, or coal dust, 51¼ per cent. A great many schemes for the manufacture of artificial fuel call for the use of peat as one of the parts of the compound.

A British subject has just taken out letters patent on a device for drying and condensing peat for fuel. His scheme is something like that of the Fort Worth man, consisting of the mixture of a lot of ingredients to produce a substitute for anthracite. Of the materials he employs the principal is peat, mixed with which is the oxide of an alkaline earth, finely divided carbon, sugar, and an alkali salt. This is pressed into blocks and sold in that shape.

Another combination of materials to make fuel includes starch, molasses, and water as a binder.

A Chicago man has a process for converting earth or soil into fuel by adding to such disintegrated material certain quantities of pitch and rosin, sawdust, sulphuric acid, and hot water.

Another scheme is to heat coal dust to the point of ignition and afterward mix it with a paraffin residuum, borax, antimony, acetic acid, oil cake meal, and crude potash.

Still another recipe for making artificial fuel is an admixture of the following: Rosin, tallow, sal-soda, alum, cider vinegar, flour paste, coal dust, and sawdust.

An inventor with an economical turn of mind and a desire to utilize trash, has secured a patent on a coal-making scheme that ought to appeal to every housewife. He proposes to convert floor sweepings and the refuse of the ash pits and dust boxes into fuel. The process is to grind these materials along with charcoal and then mix in oil so that the whole mass will assume a consistency of paste. This is then molded into shapes and dried, after which it is ready for the stove.

Inventors have tried for many years to find a scheme for utilizing the waste products of the coal mines, but so far no plan has been brought forward for converting such materials into a fuel cheaper than coal. If the strikers would permit the removal of the quantities of culm and slack that accumulate at every mine it would be possible to demonstrate the worth of some of the many inventions for converting these waste products into good fuel. Culm is found at bituminous as well as at anthracite mines, and consists of the fine coal powder which is left after the sifting process is completed for getting the coal separated according to size. There are any number of plans for mixing tar, silica of soda, and lime with this powder and pressing it into briquettes. It is claimed that fuel can be obtained in this way of a quality equal to the best anthracite or bituminous, and at a cost almost as low as that charged at the mine for the larger product.

In Germany scientific men are striving to utilize the alcohol derived from potatoes for heating and cooking.

Grass or molasses, sawdust or potatoes, culm or peat, may be the fuel of the future, but the practicability of these various substances remains to be demonstrated. The age of the briquette can be safely prophesied, but it will hardly come in this day and generation.

What is the matter with coke as a cheap substitute for coal for furnace use? The question was asked us by a correspondent recently, and deeming the matter one of considerable importance, the views of a number of representative men were solicited.

A perusal of these views of practical furnace men would indicate that counting first cost as the only desideratum, coke will be 10 to 20 per cent cheaper than hard coal. It would also appear that the householder who grumbles about the amount of attention his furnace requires when the chilly January blizzard or the crisp March zephyr is regnant without would find his labor essentially multiplied if he used coke. The majority of manufacturers hold that a coke fire requires more attention than a hard coal fire, as coke is lighter and burns up quicker.

The main objection in the letters given would appear to be that coke is too hard on the furnace. The heat being intermittent, now at a Bessemer converter glow, now at a smudgy smolder, the expansion and contraction of the metal in the furnace varies continually and the life of the furnace is shorter.

However, there is a bright as well as a somber side to this shield. If great care is used and the coke is not allowed to flame up too fiercely the preponderance of testimony would seem to be at least to tolerate if not approve of its use.

One manufacturer points out that if coke is to be used satisfactorily a furnace with a large, deep firepot is needed, as this is a bulky fuel.

So the question of coke for furnace use seems to be up to the householder.

(1) If he is willing to devote twice the cellar space to coke that his coal pile requires;

(2) If he is willing to fire the furnace oftener;

(3) If, besides this, he gives the fire extra attention so that his furnace won't look like a blooming mill crucible every day or so, wearing itself out faster than it should;

(4) If the firepot in his furnace is large enough to accommodate the coke giving out the equivalent in thermal units that the amount of coal requisite to heat his house does;

(5) If he gets the right kind of coke;

Then it would appear that he would save a small amount annually as compared with his coal bill.

The points pro and con the use of coke seem pretty well established. If we had any data concerning peat or terralig; briquettes of sawdust, paraffin and coal dust; briquettes of sulphuric acid, dirt and resin; briquettes of pretty nearly everything except salamander entrails and pulverized asbestos we would be pleased to compare them with coal as a practical fuel for every-day practical heaters, ranges, and furnaces. The genius of the briquette people seems to be in the dissemination of stock certificates in companies capitalized for $1,000,000 or $10,000,000, rather than in marketing their compounds for frying eggs and raising the parlor thermometers to acceptable figures.

Ten years from to-day the inconvenience of coke as a fuel other than its bulk—and even that may be obviated by hydraulic briquetting—may all be surmounted; means may be found whereby alcohol, oil, or peat may be manufactured and used in every kitchen or cellar; from the clash of the stock certificate battle of the

"briquetteers," the manufacturer of some weird compound of liquid glass, silicate of soda, alum, dirt, resin, tallow, flour paste, coal dust, clay, sulphuric acid, cider vinegar, lignite, peat, alcohol, crude petroleum, sugar cane, molasses, grass, tar, culm, etc., may emerge triumphant and the interior of our furnaces may be filled with prepared fuel even as the prepared foods filling human interiors to-day.—The American Artisan and Hardware Record.

THE BOTANICAL LABORATORY OF THE CARNEGIE INSTITUTION.

NEARLY six months ago the Carnegie Institution decided to enter the field of botanical research to the extent of establishing a desert laboratory for the direct benefit of botanists interested in the study of vegetation peculiar to the arid regions of America and the ultimate benefit of dwellers in such districts.

It is estimated that there are a million square miles of so-called desert in North America. Botanists have spared neither time nor toil in studying the flora of these immense tracts, but the difficulty of exploration and investigation in such inhospitable places, and the few specimens accessible for examination at home have made the growth of knowledge exceedingly slow.

For the most part these deserts are far from being the sterile wastes involuntarily associated in the mind with the term desert, and the vegetation, in the main of the succulent order, is always interesting, generally odd, and often beautiful in the season of its bloom. The greater portion of desert plants are storehouses of moisture in a dry land. Most of them, and especially the cacti and their near kin in the floral kingdom, protect their stores with almost countless spines capable of inflicting painful wounds on man and beast.

The Indian residents of the great plains have learned by necessity many ingenious methods of bending the strange ways of such plants to the needs of man, and this alone leads to the conviction that systematic study, under improved conditions, will bring about results of great importance to civilization. It was with this idea that the Carnegie Institution made an appropriation of $8,000 for the establishment of the laboratory and its maintenance for one year.

That nothing should be left undone to insure the ultimate success of the undertaking, the Executive Committee of the Institution requested Frederick V. Coville, Chief of the Division of Botany of the Department of Plant Industry of the United States Department of Agriculture, and Dr. Daniel Trembly MacDougal, First Assistant and Director of the Laboratories of the New York Botanical Garden, to look up a favorable site for the new laboratory. The selection was made after some five weeks spent in exploring desert regions and examining promising locations.

A site was selected on a small mountain in the vicinity of Tucson, Arizona. It was offered free of cost by the Chamber of Commerce of Tucson and was approved by the Board of Trustees of the Carnegie Institution. Plans for the building are well under way and will be presented for approval within a week.

The land included in the grant contains about sixty acres in the heart of a district noted for the wealth of its desert vegetation and the size which the giant cactus there attains, a height often of 80 feet, with branches as big as ordinary trees in themselves, and the weight of the plant to be estimated only in tons. The laboratory will crown the crest of the mountain, which commands a view of thirty to fifty miles on either side.

The structure will be built of the volcanic bowlders which abound on the mountain, or of adobe. A big sloping roof reaching well down to shade the windows from the sun will cover a large laboratory, a smaller room devoted to the same use, a storeroom, office, workroom, and library.

It is expected that the building will be finished and furnished ready for occupancy by September 1. Dr. W. A. Cannon, who is now assistant in the laboratory of the New York Botanical Garden, has been appointed resident investigator of the desert laboratory, and will resign his New York position and assume his new duties as soon as the building is completed.

The Chihuahua Desert was the first explored by Dr. MacDougal and Mr. Coville in their search for a desirable location for the desert laboratory, but they found the Tularosa Desert much more interesting. The dazzling white sand which prevails there makes it the most peculiar of any desert in North America, Dr. MacDougal reports. Also it makes it a most trying place to travel in because of its effects on the eyesight. It is a coarse granulated gypsum which is soluble in cold water. This gypsum covers a tract fifty miles long by twenty miles wide, and the dunes that much of it is piled into are undergoing constant change under the combined action of the wind and the rain. The solution which results from the slow melting of the gypsum is strongly alkaline, and only such plants as can withstand the alkali can exist there.

Considerable field work was done in Mexico between Los Nedano and Samalayuca, a district notable for the number and height of its great dunes of hard silicious sand, many of which attain an altitude of 200 feet, the long line of them appearing from a distance almost like a mountain range. These dunes are moving slowly across the plain in the direction of the prevailing winds. They are covering everything in their march northeastward, and are carrying with them their characteristic vegetation. Of this the yucca is the most prominent. Behind them, on the land denuded by their progress, a vegetation entirely different from that of the desert is springing up.

In the Harbor of Guaymas are a number of islands which the explorers found luxuriant with mango groves along the shores, but filled with cacti inland; the latter growth due to an odd character of rock formation on the islands. In an oasis in an arid tract near Indio, Cal., numbers of the famous Washington palm were found. It was also discovered that these palms were an unfailing indication of an underground reservoir of water, held in a hollow of the clay subsoil, or the overflow from some such reservoir near by. A knowledge of this fact may readily be of vital importance to a thirsty traveler in dry latitudes.

A hurried trip was also made to the Mojave desert, but Mr. Coville was already pretty well informed as to conditions there, the result of his previous explorations on a trip which came to be well known under the title of "The Death Valley Expedition."

Considerable work was done in the neighborhood of Nogales, a town on the border line, resting half in Mexico and half in Arizona. The last field work was done in the Grand Cañon of the Colorado to ascertain if the vegetation near the bottom was of desert character. It was concluded that the bottom of the cañon could not be properly considered desert, because it is much more liberally supplied with moisture than most arid districts, although plants native to the desert were found on dry shelves or benches on the sides of the cañon.

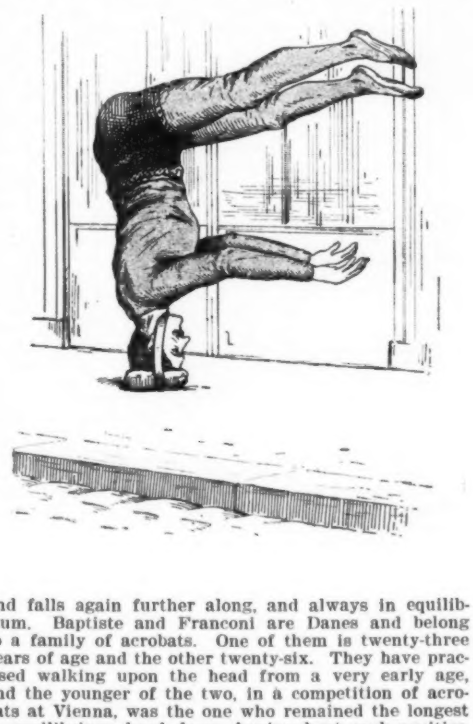
While well down in the cañon the explorers were entertained by the spectacle of a snow storm raging above them at the cañon's brink while they felt no effects of it except a very occasional drop of warm rain.

They started on the expedition from Washington on January 24, and rate the trip as being very successful. Dr. MacDougal collected many living specimens of plants peculiar to the districts which were visited, which are being cultivated and classified for exhibition in the conservatories in the Botanical Garden.

It is expected that the desert laboratory will become the Mecca of botanical students from all parts of the world, as its advantages and facilities are to be open to all botanists interested in plants of the desert.—N. Y. Times.

WALKING ON THE HEAD.

ONE of the most recent attractions at the Paris Casino is the performance of the brothers, Baptiste and Franconi, two athletes who walk, or rather hop, upon the head without the aid of their hands or feet. In order to accomplish this object, they interpose between the ground and their head a round pad held in place by a band passing under the chin. This done, they balance themselves upon the head and begin to make extraordinary leaps in a straight line. The body is raised by a contraction of the dorsal and pectoral muscles,



and falls again further along, and always in equilibrium. Baptiste and Franconi are Danes and belong to a family of acrobats. One of them is twenty-three years of age and the other twenty-six. They have practised walking upon the head from a very early age, and the younger of the two, in a competition of acrobats at Vienna, was the one who remained the longest in equilibrium, head down, having kept such position for five minutes and four seconds. It was not, however, until after eight years of incessant work, that the two brothers succeeded in walking upon the head as they do at present. Baptiste and Franconi have well proportioned bodies and strongly marked muscles, although their necks exhibit no abnormal muscular development. What is a strange thing is that they do not know what hemicrania or a headache is. Their intelligence is rather greater than the average, and they express themselves very well in French. One of them speaks nine languages. After practising their profession in Russia, Greece, and Turkey, they became desirous of obtaining the approbation of Paris. They wanted to be talked about, and it is to be foreseen that they will succeed. Meanwhile, one of them, Baptiste, has just offered a bet that he can, in six hours, walk upon his head from Place de l'Opera to the Crédit Lyonnais, the resumptions of the walking to be two minutes, with two minutes rest between each. The challenge has been accepted by M. Hippolyte Bertrand, an acrobat of Toulouse, who claims priority in the feat of walking upon the head.—Translated from La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

CONTEMPORARY ELECTRICAL SCIENCE.*

STATIONARY WIRE WAVES.—In 1892 Arons described a method of making wire waves visible by stretching two aluminium wires along a glass tube 2.5 meters long and exhausting the air down to a pressure of a few millimeters. Later on, Coolidge obtained similar luminous phenomena in the open air, but feebler. J. J. Borgmann has now obtained them on a single wire, mounted along the axis of a tube and connected with the secondary circuit of a Drude apparatus for determining dielectric constants. He used a Tesla transformer and a Blondlot vibrator fed by an induction coil of 3 centimeters spark length. Spindle-shaped luminosities are seen on the wire itself where the ventral segments of the vibrations are. On varying the position of the first bridge wire the length of the waves is altered, and hence also the number of luminous stretches on the wire. Photographic records can be obtained in about eight minutes. The diameter of the tube is of no consequence. But it must not be too highly exhausted, otherwise the glow fills the whole tube, nodes and all. A curious circumstance is that the glow does not set in at once, but two or three minutes after the current has been turned on. The interrupter must work uniformly and rather rapidly. Otherwise the phenomenon may fail entirely.—J. J. Borgmann, Physikal. Zeitschr., February 1, 1903.

MAGNETIC EFFECT OF MOVING DIELECTRICS.—H. Pender has recently shown that if an ebonite disk rotates in an alternating electric field, alternating currents are induced in a neighboring conductor. With a difference of potential of 7,470 volts he obtained a deflection of 4.5 millimeters from the current when rectified. A. Eichenwald calculates this deflection theoretically by supposing that the fictitious charges on both sides of the ebonite disk form two contrary convection currents during the rotation of the disk, and change their direction with every change of the current. The calculated value agrees closely with the experimental value, and it thus becomes clear that a fictitious charge can produce a magnetic field in the same manner as a real charge. The calculation of convection effects is thus greatly facilitated. The author has made a number of experiments with dielectrics moving in a steady electric field, and producing a steady magnetic deflection. These experiments have the advantage that no transformation of energy takes place. He proves that if a condenser is charged to a certain difference of potential, and moved together with the dielectric, it exerts a magnetic effect independent of the material of the dielectric. The essential element in this convection effect seems to be the motion of the charge relative to the electric field generated by the electric charge itself in moving through a fixed ether.—A. Eichenwald, Physikal. Zeitschr., March 1, 1903.

SEISMOGRAPHS.—G. Lippmann has devised an electric contrivance for setting a seismograph in motion. The ordinary Italian seismographs are subject to an imperfection which prevents them from registering a disturbance from its very beginning. In order that the curve of a seismograph should be easily measured, it is necessary that it be traced on paper having a certain velocity. The instruments in which the drum is in motion night and day do not move more than 0.05 or 0.1 millimeter per second. If the velocity is increased, it is necessary, for the sake of economy, to employ an apparatus which only moves during the earthquake shocks. Therefore, the drum must be released a few seconds before the shocks arrive. The author employs three stations, A, B, and C, several miles apart. At A an electric alarm is stationed, which, on receiving a shock, releases the seismographs at B and C. This release is accomplished with the velocity of telegraphic transmission, whereas the earthquake shock is propagated only with the velocity of sound through solids. If the three stations are placed in a triangle, and alarms attached to each, registration can be effected from whatever direction the shock may come. The apparatus can also, under favorable circumstances, be used for determining its velocity of propagation.—G. Lippmann, Comptes Rendus, January 26, 1903.

RADIO-ACTIVITY AND GRAVITATIONAL ENERGY.—R. Geigel has made some experiments with the object of determining whether the energy of radio-activity is derived from gravitational energy. He suspended a small bob of lead weighing 6.5 grammes over a watch-glass containing 1 gramme of radio-active substance (kind not specified), and noticed a temporary diminution of weight amounting to 0.035 milligrammes. He supposes that "rays" of gravitational energy proceed from the whole earth toward the lead, and are partly intercepted by the radio-active substance. On this assumption he calculates the intercepting or absorbing power of the radio-active substance, varying the distance and dimensions of the substance for the purpose. The thickness of the radio-active layer varied from 3 mm. to 21 mm., and its width from 7 mm. to 19 mm. He found that immediately after stirring the substance the loss of weight was greater, and also that some loss of weight remained after removing it. The whole reasoning appears to be somewhat loose. If energy is absorbed there should be a permanent loss of weight, unless its restitution is accounted for. If force only is intercepted, there is no loss of energy and no explanation of the radio-active energy. In any case a reduction of the radio-active surface does not bring about a smaller loss of weight.—R. Geigel, Ann. der Physik, No. 2, 1903.

EARTH-CURRENT DISTURBANCES.—Sir Oliver Lodge makes an interesting communication on some characteristic electric earth-current disturbances observed in recent experiments in wireless telegraphy. In the Post Office system a sensitive telephone receiver is connected in a low-resistance circuit earthed in the sea at both ends. The disturbances evince themselves by producing various characteristic noises in the telephone receiver, though far removed from the usual inductive influences. They are stronger in summer than in winter, and strongest about sunset. They may be divided into noises resembling (a) uniform flowing or rushing of water, (b) intermittent crackling, (c) bubbling and boiling of water, (d) rocket disturbances, and (e) high-frequency disturbances inaudible in the telephone but evidenced by the coherer or other detector. The rocket disturbances commence with a shrill whistle, and die away in a note of diminishing pitch. They are probably due to meteorites rushing through the atmosphere and producing electric disturbances of diminishing frequency as their velocity decreases. They are more usually observed at night time, not because meteorites are more frequent then, but because in daylight the highly ionized air screens the effect by absorption. At nightfall the day ionization disappears, and the clearing-up is accompanied by the noises described.—O. Lodge, Proc. Roy. Soc., January 22, 1903.

* Compiled by E. E. Fournier d'Albe in the Electrician.

ELECTRICAL NOTES.

A practical trial of the Stassano electrical process for smelting iron ore is to be made under the auspices of the Italian government, and a power plant rated at 500 horse power is being erected in Piedmont. This will be the first trial on a large scale, and will do something toward determining the practicability of the process. After all, the main point to be settled is the cost compared with that of iron smelted with coal. As to this there is no doubt in any country, or any place, where mineral fuel can be obtained at a reasonable price. The only opportunity for the electric process is in countries where fuel is costly and water power abundant.—Eng. and Mining Journal.

In the earlier stages of wireless telegraphy an important part was ascribed to the earth, as all the devices had to be carefully earthed. As, however, the Braun system showed earthing to be apparently unnecessary, most experimenters would adopt opposite views, the transmission of electrical waves being considered as analogous to the propagation of luminous waves. The fact that the curvature of the earth should be so easily overcome was, it is true, an enigma unsolved. It is the more difficult to decide this question, as even with Braun's system the co-operation of the ground is never wholly to be dispensed with, the heights attained in studying the problem being, on the other hand, too small as compared with the dimensions of the earth. In order, however, to arrive at a partial solution, the author endeavors to show that the effects exerted on the earth by an ordinary transmitter are such that her electrical potential is influenced by them to a marked degree, the working of the most sensitive receiving station being explained in this way. It is shown that the earth has by no means an electrostatic capacity of extreme magnitude, it being equivalent to the radius of earth, viz., 6.37×10^8 centimeters or 708 microfarads. The author gives a theoretical proof of the possibility of disturbing, in a noticeable manner, the potential of a sphere of this capacity with the limited resources of modern wireless telegraphy. If the author's theory were true, Marconi's system would turn out to be an earth telegraphy. In concluding his deductions the author is compelled to confess the boldness of his theory.—Dingler's Polytechnisches Journal.

In spite of the work which has been done on the Nernst lamp, it has thus far made slow progress in American practice. The mercury arc is in a frankly experimental stage from which it may be expected to emerge albeit perhaps somewhat slowly. Meanwhile work on vacuum tube lighting proper goes on slowly and with somewhat indecisive results. Another promising line of investigation, on arcs between pencils in which carbon enters in part or not at all, is being vigorously pursued, but still with the promised land just a few days' march ahead. After all the research of the last five years or so, the incandescent lamp holds the field against all comers in spite of its manifest limitations. The inclosed arc has pushed its way into extensive use in this country, but is little used elsewhere on account of the large energy consumption of the device as a whole. American requirements demand the saving of labor as of prime importance, and no device that increases this item can make its way except by overcoming extreme inertia. The added labor in cleaning and renewals is one of the factors that tends against the Nernst lamp as against the incandescent. The mercury arc ought to be helped by this consideration unless the renewals should prove to be heavy. Technically the situation is extremely interesting, with four or five forms of high-efficiency lamps far advanced in the experimental stage and already beginning to find place in commercial practice. Eventually a device which is technically good is bound to make its way in the world, but sometimes very slowly against the pressure of competition. In the present instance it may be regarded as certain that some of the newer illuminants will come into considerable use; but which, it would be rash to predict. No one of them seems to have, however, the elements of success to the point of revolutionizing the general art of illumination.—Electrical World and Engineer.

The Electrician republishes from the Elektrotechnische Zeitschrift a simple formula, which may be used for either determining the main dimensions of a new open type dynamo or motor, or by reversing the calculation and inserting the dimensions of a machine made, for arriving at its commercial efficiency. The formula in question is $D^2ln/kw = K$, where D = diameter of armature in centimeters, l = effective length of armature in centimeters, n = revs. per minute, and kw. = output (for dynamos) and input (for motors) in kilowatts. The constant K has been found empirically from a large number of the most successful machines in electrical as well as in commercial respects, and is approximately as follows for machines of various sizes:

1 kilowatt	220×10^4
2 kilowatts	145×10^4
3 kilowatts	120×10^4
4 kilowatts	110×10^4
5 kilowatts	100×10^4
6 kilowatts	95×10^4
8 kilowatts	90×10^4
10 kilowatts	83×10^4
12 kilowatts	78×10^4
15 kilowatts	72×10^4
20 kilowatts	66×10^4
30 kilowatts	58×10^4
40 kilowatts	53×10^4
50 kilowatts	49×10^4
60 kilowatts	47×10^4
100 kilowatts	45×10^4

For voltages above 220 volts the figures are somewhat higher.

500 kilowatts	40×10^4
1,000 kilowatts	35×10^4

For all practical voltages.

The output of semi-inclosed and fully-inclosed machines is limited by the temperature rise, and actual tests on a number of machines which were run successively as open type, semi-inclosed type, and fully-inclosed type, tend to show that the ratio of their capacities is, approximately, **as 2 : 1½ : 1.**

ENGINEERING NOTES.

Traction engines in South Africa are being employed in several cases for hauling coal from the railway to mines which have no direct railway communication. Formerly ox wagons were used, but oxen are now very scarce, and the engines are much more economical. The cost of an ox wagon, including Boer driver, native attendant and maintenance, is estimated at $5 per day. It will average 16 miles in 24 hours, so that it can deliver one load of 7 tons at a distance of 8 miles. This gives a cost per ton-mile of 8.9 cents. A steam traction engine can haul 20 tons of coal and can travel 20 miles in 8 hours. The cost for this 8 hours' service is $10—$5 for the driver, $2.50 for fuel and maintenance, and $2.50 for supplies and maintenance of wagons. This gives a cost per ton-mile of 5 cents. In both cases the time occupied in returning empty is allowed for. At the present time there are said to be about 12 engines and 70 wagons employed in freight transportation, and mainly hauling coal.—Engineering News.

It is not claimed that wood cannot ultimately be disintegrated and destroyed by attacking flame, but it is claimed that wood may be so treated that it will not of itself hold flame, except perhaps momentarily. Certain chemical solutions, when injected into the cellular structure of wood and afterward dried, leave a residual deposit which has in one case a preservative and in another a fire-resistant effect. The mechanical saturation of wood is really a new art. It found its first development in apparatus designed to saturate timbers with preservative solution. Wood treated to make it fire-resistant is subjected to many stringent requirements not essential for preservative treatment. For instance, the saturation must be complete to the heart, the color must not be impaired, the strength of fiber must be preserved, and there must be no linger of flame on withdrawal of attacking flame. To comply with these requirements the strength of solution must be as high as possible. "Gaseous emission" chemicals were the only materials used, up to five years ago, in any commercial fireproofing plant. It became necessary to seek for materials acting on a reverse principle from that of the gaseous emission, and after years of effort sulphate of aluminium was found to be the substance endowed with the property of fire-resistance beyond any previous conception. This satisfactory result comes from the fact that sulphate of aluminium under flame is reduced to pure alumina, which has the property of expansion in the cells of wood to two, two and a half, or three times the original volume of dry sulphate, and in doing so it interposes a compact mass between flame and wood fiber; therefore the fire resistance achieved in saturated wood proceeds from the massing within it of an inert and infusible substance which, from its non-conducting character, bars destructive heat, giving absolute negation to flame for a prolonged period of time. This seems to show that the "massing" principle is correct, and the principle is further illustrated and confirmed by its extension to the preservation of existent structures from attack by fire. A chemical substance was discovered possessed of extraordinary penetrative power, a simple application entering ¼ inch below the surface of oak. By subsequent coatings other chemicals, making chemical union with the first, insured adhesion and condensation; and an enamel grew upon the wood surface possessing a fire-resistance over six times that of wood treated by sulphate of ammonia solution.—Joseph L. Ferrell, Proc. Eng. Club, Philad.

Results obtained on small samples are very different to those arrived at in actual practice when large masses of steel are subjected to similar heat treatment. The author therefore decided to investigate heat treatment under actual works conditions. With this object in view a number of round bars, varying in size from 1½ inches to 6 inches diameter, and in carbon content from 0.20 to 0.65 per cent, have been heated to different temperatures for various lengths of time. The bars after treatment have been subjected to as complete a set of mechanical and other tests as possible, to determine the influence of the particular treatment on the strength, ductility, and general physical properties. The general conclusions to be drawn from the results may be thus summarized: Small sections of rolled steel containing 0.20 per cent carbon can be heated within wide limits without seriously affecting resistance to impact, but 850 degs. C. is the maximum temperature to which such material should be heated, and slow cooling tends to produce brittleness. For larger rolled sections containing 0.20 per cent carbon, 800 degs. C. is the maximum temperature. Forged bars of the same steel should not be heated beyond 850 degs. C. Between 500 and 600 degs. C. brittleness is produced in a marked degree, especially if followed by slow cooling. The best temperature at which to treat such material is 800 degs. C. Small sections of rolled steel containing 0.30 to 0.40 per cent of carbon are improved in shock-resisting qualities when heated to 650 to 800 degs. C., whether followed by slow or rapid cooling. Heating between 500 and 600 degs. C. does not produce brittleness as in 0.20 carbon steel. Large rolled bars give the best results after heating to 700 to 800 degs. C. with the maximum resistance at 760 degs. C. When heated at 900 degs. C. and higher, a pronounced brittleness develops. Slow cooling does not seem to be very injurious. Steel containing 0.50 to 0.60 per cent carbon, in small and large rolled sections, appears to be in its toughest and strongest condition after being heated to 700 to 800 degs. C., and followed by either slow or rapid cooling. Forged bars require to be heated to a slightly lower temperature than rolled bars. Steel containing between 0.60 and 0.70 per cent of carbon in small rolled sections possesses greatest ductility and resistance to sudden shock after being heated to 600 to 700 degs. C. The 4-inch rolled bars of this steel give the best drop-test results at about 720 degs. C. The rate of cooling apparently does not very much influence the results. Forged bars of 6 inches diameter give the best results under the falling weight test after being heated to 700 to 760 degs. C., and followed by either rapid or slow cooling. Heating this grade of steel in large bars to temperatures of over 850 degs. C. produces brittleness, which is very marked if the temperature exceeds 900 **degs. C.—A. Campion, Jnl. Iron and Steel Inst.**

TRADE NOTES AND RECIPES.

To Remove Picric Acid Stains.—Dr. Prieur, of Besançon, recommends an aqueous solution of lithium carbonate for the removal of picric acid stains from the skin or from linen. A very small quantity of the agent is necessary, and the method of using it is simply to lay a small pinch of the agent on the stain, and moisten the latter with water. Fresh stains disappear almost instantly, and old ones require only a minute or two to fade out.—Nat. Drug.

Artificial Buttermilk.—The cooling and grateful effects of buttermilk are so highly appreciated in the hospitals of Paris, that, in the absence of the fresh article, the physicians have devised the following formula for the preparation of an artificial substitute for the genuine article:

Buttermilk powder (see below)	10 parts
Vinegar	1 part
Syrup of buckthorn	1 part

Dissolve the powder in the water and add the vinegar and syrup.

The powder is prepared as follows:

Sodium chloride	50 parts
Milk sugar	100 parts
Potassium nitrate	5 parts
Alum	5 parts

Mix.—Nat. Drug.

To temper a tap, after the tap has been cut and finished take it in a pair of tongs and heat it to a blood-red heat over a charcoal fire or the blue flame of a Bunsen burner or blowpipe, turning it around so that one point does not get heated before another. Have ready a pail of clean, cold water, into which a handful of common salt has been put. Stir the water in the pail so that a whirlpool is set up. Then plunge the tap, point first and vertically, into the vortex to cool. The turning of the tap during heating, as well as the swirl of the quenching water, prevents distortion. In tempering, the temper of the tap requires to be drawn to a light straw color, and this may be done as follows: Get a piece of cast-iron tube about 3 inches in diameter and heat it to a dull-red heat for about 4 inches of its length. Then hold the tap, with the tongs, up the center of the tube, meanwhile turning the tap around until the straw color appears all over it. Then dip the tap in the water, when it will be found perfectly hard. The depth of the color, whether light or dark straw, must be determined by the nature of the cast steel being used, which can be gained only from experience of the steel.—Mining and Scientific Press.

Powdered Camphor in Permanent Form.—A method of "reducing camphor to a powder which will not become lumpy or run together again," recommended by a number of writers, is the following:

Powder the camphor in the usual manner, with the addition of a little alcohol. When it has nearly reduced to the proper degree of fineness, add a few drops of fluid petrolatum and immediately triturate again. In this manner a powder as fine as flour is obtained, which does not cake together. This powdered camphor may be used for all purposes except for solution in alcohol, as it will impart to the latter a faint opalescence, owing to the insolubility of the petrolatum.

A similar method recommended some years ago by John K. Williams, an English pharmacist, consists in taking equal parts of stronger ether and alcohol to reduce the camphor to powder, the claim for this method being that it only takes one-half of the time required when alcohol alone is used, and the camphor dries quicker. Before sifting add 1 per cent of white vaseline and 5 per cent of sugar of milk. Triturate fairly dry, spread out in the air, say fifteen minutes, then pass through a moderately fine wire sieve, using a stubby shaving brush to assist in working it through.—Pharmaceutical Era.

Harness Dressings are in many instances similar to shoe dressings and blackings, and many preparations ued for the latter purpose may be used for application to harness. Here are some formulas:

Blacking.

1. Mutton suet	2 ounces
Beeswax	6 ounces

Melt and add

Sugar (in fine powder)	6 ounces
Soft soap	2 ounces
Lampblack	2½ ounces
Indigo (in fine powder)	½ ounce

When thoroughly incorporated, add turpentine, 4 ounces, and pour into tins or other receptacles.

Oil.

2. Black aniline	35 grains
Muriatic acid	50 minims
Bone black	175 grains
Lampblack	18 grains
Yellow wax	2½ av. ounces
Oil of turpentine	22 fl. ounces
3. Oil of turpentine	8 fl. ounces
Yellow wax	2 av. ounces
Prussian blue	½ av. ounce
Lampblack	¼ av. ounce

Melt the wax, add the turpentine, a portion first to the finely powdered Prussian blue and lampblack, and thin with neatsfoot oil.

Vaseline Composition.

4. Prussian blue, in fine powder, ¾ ounce; lampblack, 4 ounces; molasses, 2 ounces; soft soap, 3 ounces. Mix together in a large mortar, previously warmed, and add: Vaseline, 6 ounces, ceresin, 5 ounces; yellow resin, ½ ounce; melted together, then sufficient turpentine to give the composition the proper consistence. Mix thoroughly.

Varnish or "Reviver."

5. Dissolve in about half a pint of methylated spirit 2 ounces of shellac, ½ ounce of Venice turpentine, and 1 ounce of gum benzoin. Stir in a sufficiency of a mixture of 4 parts drop black, and 1 of indigo blue, to form a deeply colored varnish, then make up with spirit to the measure of 1 pint. Apply with **a sponge or soft brush.—Pharm. Era.**

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

French Chamber of Commerce.*—A chamber of commerce in France may only be established by act of government. They are only created after a thorough investigation as to the utility of such an institution in the district where it is demanded. There are 137 chambers of commerce in France, including those in Algiers and Tunis, and 28 in the French colonies. There are also 27 French chambers of commerce in foreign countries.

The duties of a French chamber of commerce are to furnish the government with such advice and information as may be required concerning commercial and industrial facts and interests. The chambers must make a thorough study of all the conditions surrounding public works, harbors, river navigation, post-offices, railroads, etc., in their respective districts, and be able to furnish the government with reliable information at any time. Especially has this been the case in aiding the government to prepare tariff legislation and commercial treaties. The chambers are often called upon by the government to provide part of the funds necessary for the execution of such public works as harbor improvements, the equipment of working plants of ports, construction of telephone and telegraph lines, etc. In such cases, the chambers are authorized by special acts of Parliament to contract loans for this purpose. The cost of the improvements now under construction in the port of Havre, for example, is estimated at $5,790,000, of which the government provides $3,332,750 and the chamber of commerce in that city $2,457,250. French chambers of commerce also take a lively interest in the founding of commercial and industrial schools.

French chambers of commerce in foreign countries are to a certain extent independent organizations. Their object is to protect French interests in furnishing to the government and the chambers of commerce in France such reports and information as may tend to promote the commerce and industry of France. They are also called upon to furnish statistics, to organize museums of samples, to serve as tribunals of arbitration and conciliation concerning commercial disagreements between resident Frenchmen, and to keep in touch with the French consular representatives. The yearly subvention budget of the French government to-day includes $19,300 for the purpose of helping these chambers of commerce in every part of the world. These institutions are placed on an equality with the home chambers, with which they maintain regular correspondence. When requested, they appoint reliable agents in foreign countries and give information concerning the standing and credit of business houses.

The chambers of commerce in France, and as a rule those in the colonies, receive no subventions from the government directly; but by virtue of the laws existing they receive a portion of the special tax paid by merchants and others engaged in business. Every year chambers of commerce present the budget of their receipts and expenditures, and the Minister of Finance increases or decreases, as the case may be, the special tax on merchants in order to meet the requirements of the budgets.

The bulletin issued by the American chamber of commerce in Paris says:

"Chambers of commerce in France report to and correspond directly with the minister of commerce. Those of Algeria report directly to the minister of commerce, sending, however, copies of their communications to the prefect of the department and to the governor-general; those of Tunis communicate with the French resident.

"Those of the colonies correspond directly with the minister of colonies, informing, however, the local administration of the communications they send to the government.

"Chambers of commerce in France, in the colonies, and in foreign countries, as far as can be ascertained by their published reports, accomplish very good work in promoting the industry and trade of the country, and judging from the requests for reports and information which are made by the government, their services must be considered of value.

"Besides the chambers of commerce already mentioned, there exists the national office of foreign commerce, which was created by convention between the minister of commerce and the chamber of commerce of Paris and by virtue of the law of March 4, 1898.

"The objects of this office are to furnish French manufacturers and merchants commercial information of a nature tending to increase the outlets for French trade in foreign countries and in the French colonies and protectorates. The minister of commerce and the president of the chamber of commerce in Paris are, respectively, president and vice-president of this organization. The managing director is appointed by the minister of commerce. This office is well equipped, well managed, and does efficient work in the way of giving information. The Moniteur Officiel du Commerce is edited and published by this office and always contains valuable information.

"In all the departments of the French government there are certain special councils or commissions, in some of which chambers of commerce are represented by their delegates. For example:

"By virtue of the laws of October 13, 1882, and December 1, 1894, there was created in the ministry of commerce a superior council of commerce and industry, which is under the supervision of the minister of commerce and is composed of 60 members, two of whom are vice-presidents. The council is divided into two sections: (1) Section of commerce; (2) section of industry. Each of the sections consists of 30 members, 15 of whom are chosen among the presidents of the chambers of commerce."

The systematic work of the French chambers of commerce is of great value, while the twenty-seven chambers established in as many emporiums of trade in different parts of the world may well serve as models for other countries contemplating the organization of similar institutions. The chambers of commerce in the colonies have been of valuable service in giving information to the government and colonists about the climate, cost of labor, the capital necessary to exploit concessions of various kinds, natural resources, native products, cost of inland freight, etc. They have also done much to assist the mother country in introducing public works, and have taken the initiative in starting all sorts of enterprises, such as railroads, plantations, and mines.—Ernest L. Harris, Commercial Agent at Eibenstock.

* For other reports of this series see Advance Sheets Nos. 1136 and 1650. I am indebted for the facts in this report to Bulletin No. 21, issued by the American Chamber of Commerce in Paris for the month of April, 1903.

British Engineering Standards Committee.—A pamphlet giving a short account of the engineering standards committee and its work has been issued by Messrs. Robert Atkinson, Limited, the compilers and publishers of the British engineering standards coded lists, issued by authority of the standards committee. It contains a list of the various committees and sub-committees engaged in considering the question of standardization, together with the names of the members who compose them and a statement of the work with which each is occupied.

The committee on sections used in shipbuilding—such as bulb angles, bulb tees, bulb plates, etc.—has been engaged in deciding on a series of sections which, on the one hand, would give sufficient graduation, and on the other would be as small as possible, so as to reduce to a minimum the plant and stock of rolls to be kept by manufacturers; and a further sub-committee is deliberating on the most suitable tests to be applied to iron and steel material used in the construction of ships and their machinery, with the object of arriving at a common basis of agreement between the many divergent specifications and restrictions at present in vogue.

The committee on bridges and general building construction has been chiefly engaged in drawing up a series of standard beams and tees and in the consideration of "equal and unequal angles." Their standard list of beams includes only 30 sections—a considerable reduction on the number formerly in use—and some of the leading firms have already announced that they are returning their rolls to comply with the committee's standard list.

In railway matters, there is a committee on rolling stock underframes; another on locomotives, with sub-committees on component parts and types, on steel plates, on tires, axles, and springs, and on copper and its alloys, and a third on rails. The last-mentioned is divided into two sub-committees; the first, on railway rails, is engaged in drawing up a series of standard flat-bottom rails and bullheaded rails, the former beginning at 60 pounds per yard and the latter at 20 pounds per yard, and rising by increments of 5 pounds to 110 pounds per yard; while the second, on tramway rails, has agreed on a standard series advancing by steps of 5 pounds from 90 pounds to 110 pounds per yard, which has already been finally approved by the board of trade.

The committee on electrical plants is divided into four sub-committees. One—on generators, motors, and transformers—is collecting evidence as to how far standardization can be introduced in the construction of those machines and their component materials. Another—on temperatures—is conducting experiments to determine the ability of different insulating materials to withstand heat, and also the deteriorating effects produced by their exposure to heat over long periods. A third is considering the standardization of cables and of underground conduits other than tramway conduits, and is engaged in drawing up standard tables which should simplify and cheapen the manufacture of cables. The fourth is occupied in the preparation of standard tables and specifications for wires and with other matters directly affecting the construction of telegraphs and telephones.

The remaining committees are concerned with screw threads and limit gages, with pipe flanges, and with cement, there being also a committee for publications and calculations and another for finance.

Some two dozen representatives of public departments—such as the War Office, the Admiralty, the Board of Trade, and the Indian Office—are serving on these different committees, and the government has further shown its appreciation of the work by coming to its financial assistance with a grant of £3,000 ($14,598).—Marshal Halstead, Consul at Birmingham.

Siberian Trade Notes.—Russian Manufactures.—Russian goods are beginning to compete with English goods in the Asiatic markets with some success, especially in Korea and in the vicinity of the Chinese boundary. The pioneer in this line is a Moscow manufacturer, N. I. Konshin, who has already a number of representatives in China and Korea.

Butter Trade.—It is proposed to send to Manchuria during 1903 about 300,000 poods (10,833,600 pounds) of butter. As most of this (7,222,400 pounds) will be shipped during the summer months, the Trans-Baikal line is making preparations for the necessary refrigerating cars and boxes and cold storage.

Russian Trade with the Far East.—The decline of the Russian Far Eastern trade is shown by the statistics of the goods transported from European Russia to the ports of the Pacific. According to an official report the goods transported in 1900 amounted to 51,157,000 rubles ($26,345,853), while in 1901 and 1902 they amounted to 49,827,000 rubles and 37,704,000 rubles ($25,660,905 and $19,417,560), respectively.

Railway and Steamship Time-Table.—According to the changes announced in the time-table of Siberian trains the express steamers of the Chinese Eastern Railroad will leave Dalny from April 30 to May 13 for Nagasaki and Shanghai on Wednesdays and will arrive at Dalny on Tuesdays. The express trains of the Chinese Eastern Railroad will leave Dalny from April 15 to 28 on Tuesdays and Saturdays and will arrive at Dalny on Wednesdays and Saturdays.

The fast steamer "Mongolia" recently brought from Shanghai to Dalny 21 cabin passengers, nearly all of them foreigners going across Manchuria, 10 of whom went by express train. This express train does not, however, make exceptional time, arriving at the station Manchuria only four hours ahead of the ordinary train for passengers and goods.

Eastern Railroad Building Expenses.—During the years 1899-1901 the Russian Imperial Treasury paid out 222,174,700 rubles ($114,419,970) for the building of the Chinese Eastern Railroad. Up to January 1, 1902, obligations were deposited for further exploitation to the amount of 257,000,000 rubles ($132,355,000).—R. T. Greener, Commercial Agent at Vladivostock.

Japan and the Yangtze Trade.—It is evident that the statesmen and capitalists of this country (Japan) intend to take a prominent part in the development of trade and commerce on the Yangtze. Many of Japan's leading lines of steamers are emulating each other and foreigners in their efforts to establish trade relations at all available points on the Yangtze—China's greatest river. The contest that is sure to come will be for a long time between England, Germany, and Japan. A day is to come, however, unless appearances are deceiving, when United States ships will be found all along the Yangtze docking and disposing of their manufactured products.

The following table shows the percentage of shipping on the river:

	Per cent.
British	51.2
German	17.5
Chinese	17.1
Japanese	10
American	1.6
Russian	.6
All others	2

—Samuel S. Lyon, Consul at Kobé.

Trade Opportunities in Bulgaria.—According to a recent report by the British consul-general at Sofia, published in the Board of Trade Journal, London, a larger trade in dyes, paints, etc., glass and glassware, and paper and paper goods could be had by working for the trade. In all woolen cloths, continues the report, there is a large and increasing business, but buyers complain of the necessity of buying whole pieces of 40 or 50 yards of very expensive material, thus locking up a large capital. The report also states that the steady increase of Italian cotton imports is still a remarkable feature of the local trade. There is stated to be a certain opening for trade in machinery, and that sewing, knitting, and agricultural machines and implements could be pushed with advantage.

Tenders for the Supply of Hospital Stores in Egypt.—The Egyptian Journal Officiel of June 22 announces that tenders will be received at the central administration, sanitary department, Cairo, until 1 P. M. on August 31, 1903, for the supply of hospital stores and equipment, consisting of calicoes, flannels, blankets, kitchen utensils, etc., necessary for the year 1904. Forms of tender, samples, and all information may be obtained on application to the director of stores, central administration. Offers should be made on stamped paper. Tenders should be addressed "Director-General, Sanitary Department, Cairo," and marked in left-hand corner "Tender for hospital stores, etc." The director-general reserves to himself the right to refuse or accept any tender or part of tender.

Reduction of Duty on Candles in Honduras.—Consul William E. Alger, of Puerto Cortes, reports, under date of June 25, 1903, that by a decree of May 30 customs duties on candles have been reduced as follows, per kilogramme (2.2046 pounds):

Description.	Old tariff. Honduras currency.	Old tariff. United States currency	New tariff. Honduras currency.	New tariff. United States currency.
	Cents.	Cents.	Cents.	Cents.
Stearin	30	10.56	10	3.52
Wax	60	21.12	20	7.04
Tallow	20	7.04	6	2.11

Exhibition at St Petersburg.—The Department of State has received from the Russian embassy copies of rules for an international scientific industrial exhibition to be held at the Palace Tauride, St. Petersburg, in November, 1903. The exhibition is designed to give a picture of a child's life, including nourishment, dress, instruction, and surroundings. Copies of the rules are filed in the Department of State, and will be distributed to parties interested.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. The other Reports can be obtained by applying to the Bureau of Trade Relations, Department of Commerce and Labor, Washington, D. C. Since the number of Reports is limited, application for those which are desired should be made immediately.

SELECTED FORMULÆ.

Deep Black Writing Ink.—The Drogisten Zeitung is authority for the following:

Prepare beforehand a solution of extract of logwood, by heating in a water-bath 1 part of the best French extract in 50 parts of water. Set this solution aside for a week, at the end of which time carefully decant the clear fluid. To 200 parts of this stock solution add 500 parts of water and place in a water-bath, bringing the heat up to about 90 deg. C. Add 2 parts potassium dichromate, 50 parts chrome alum, and 10 parts of oxalic acid, the whole dissolved in 150 parts of water. This solution must be added little by little, very slowly, and carefully with frequent stirring. Continue the heat for a half hour, keeping the temperature as near 90 deg. C. as possible. At the expiration of this time, add sufficient water to make the whole 1,000 parts, and 1 per cent of carbolic acid. Set aside for two or three days, then decant the clear liquid and fill into bottles.

The Zeitschrift des allgemeinen Oestreichischen Apotheker Verein gives the following:

First make a tincture of jaborandi, using 200 grammes of the leaves to 700 grammes alcohol of 95 per cent, 300 grammes water, and digesting together for 8 days. Press out and filter. Then compound as follows:

Jaborandi tincture, as above	1,000 parts
Alcohol, 95 per cent	700 parts
Water	300 parts
Glycerin	150 parts
Perfume, violet water	100 parts
Caramel, to about the color of Hungarian wine.	

Here is another preparation, from the same source:

Jaborandi tincture, as above	1,000 parts
Alcohol, 95 per cent	1,500 parts
Quinine tannate	4 parts
Peru balsam	20 parts
Heliotrope essence	50 parts

Dissolve the quinine and balsam in the alcohol, add the tincture and essence. Let stand a week and then filter.

The directions to go with these preparations are as follows: Rub into the scalp twice a week, before going to bed.

Birch Water.—Birch water, says the Pharmaceutische Zeitung, of Berlin, which has many cosmetic applications, especially as a hair wash or an ingredient in hair washes, may be prepared as follows:

Alcohol, 96 per cent	3,500 parts
Water	700 parts
Potash soap	200 parts
Glycerin	150 parts
Oil of birch buds	50 parts
Essence of spring flowers	100 parts
Chlorophyll, q. s. to color.	

Mix the water with 700 parts of the alcohol, and in the mixture dissolve the soap. Add the essence of spring flowers and birch oil to the remainder of the alcohol, mix well, and to the mixture add, little by little, and with constant agitation, the soap mixture. Finally, add the glycerin, mix thoroughly, and set aside for 8 days, filter and color the filtrate with chlorophyll, to which is added a little tincture of saffron. To use, add an equal volume of water to produce a lather.

Another formula is as follows:

Alcohol, 96 per cent	2,000 parts
Water	500 parts
Tincture of cantharides	25 parts
Salicylic acid	25 parts
Glycerin	100 parts
Oil of birch buds	40 parts
Bergamot oil	30 parts
Geranium oil	5 parts

Dissolve the oils in the alcohol, add the acid and tincture of cantharides; mix the water and glycerin, and add, and, finally, color as before.

Waterproof Shoe Polish.—The following are said to give waterproof polishes on leather:

I.

Beeswax	18 parts
Spermaceti	6 parts
Spirit of turpentine	65 parts
Asphaltum varnish	5 parts
Powdered borax	1 part
Frankford black	5 parts
Prussian blue	2 parts

Melt the wax and add the borax, stirring well, and heating until the mass resembles jelly. In another vessel melt the spermaceti, add the varnish previously mixed with the turpentine, stir well and add to the wax. Finally add the coloring material previously rubbed smooth with a little of the mass.

II.

Spermaceti	3 ounces
India rubber	¾ ounce
Tallow	8 ounces
Lard	2 ounces
Amber varnish	4 ounces
Lampblack	1 ounce

Melt the rubber in the spermaceti by a long-continued gentle heat, and add the other ingredients.—Druggists' Circular and Chem. Gaz.

Ink Erasers.—Inks made with nutgalls and copperas can be removed by using a moderately concentrated solution of oxalic acid, followed by use of pure water and frequent drying with clean blotting paper. Most other black inks are erased by use of a weak solution of chlorinated lime, followed by dilute acetic acid and water, with frequent drying with blotters. Malachite green ink is bleached by ammonia water; silver inks by potassium cyanide or sodium hyposulphite. Some aniline colors are easily removed by alcohol, and nearly all by chlorinated lime, followed by diluted acetic acid or vinegar. In all cases apply the substances with camel's hair brushes or feathers, and allow them to remain no longer than necessary, after which rinse well with water and dry with blotting paper.—Pharm. Era.

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